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EXECUTIVE SUMMARY

Childhood asthma imposes a heavy burden on health care resources and on families. Low income children use more urgent care for asthma than other populations. In an Interim Report to Congress in 1992, HCFA reported that pediatric asthma was the highest volume non-pregnancy related condition treated on an inpatient basis in the non-elderly Medicaid population, accounting for 12% of these admissions. The Report estimated that admission rates for pediatric asthma were 75% higher in the Medicaid population than in the non-Medicaid population. In 1990-91, the Coordinating Committee of the National Asthma Education Program (NAEP) convened an expert panel to develop guidelines for the diagnosis and management of asthma. They stated "With appropriate therapy, patients with asthma can expect to control their symptoms, prevent most acute exacerbations, maintain the activity levels they desire, and attain near normal lung function". The 1991 NAEP expert panel report was part of an effort to "bridge the gap between research and practice" in asthma care, and was widely distributed among physicians. An updated panel report was produced in 1997.

The first purpose of this study was to examine whether asthma medication regimes for children covered by Medicaid are in compliance with the recommendations made by the NIH consensus National Asthma Education Project in 1991. Using 1994-1995 Medicaid claims, we examined compliance in two states, Alabama and Michigan, and assessed the generalizability of our observations concerning asthma medication utilization across states. We also assessed whether features of a child's health care utilization were associated with compliance or non-compliance with asthma medication regimes. In addition, we examined expenditures on different types of asthma care in the two states, and explored whether expenditures on medications substitute for expenditures on urgent or routine medical care.

The second purpose of this study was to assess the accuracy of Medicaid claims data compared to medical records data for identifying problems in the pharmaceutical treatment of asthma. We selected a small sample of children in Alabama with asthma in 1995, and requested full year ambulatory and inpatient records for the time period extending from January 1, 1994 to March 31, 1995 from all of the providers who filed claims on behalf of these children. We compared selected elements from the abstracted record to corresponding Medicaid claims filed for care on the same date, or, in the case of medications, for twelve months following the date of care. We report here the extent to which conclusions about the content of a child's care imputed from Medicaid claims correspond to conclusions reached based on record review. We pay particular attention to whether claims filed for prescription medications reflect prescriptions recorded in medical records.

The third purpose of this study was to use claims data to simulate a letter reminder system that would notify physicians if claims data indicated deficiencies in medications and other types of car provided to children with asthma. We examined whether the physicians associated with care problems are a small or large segment of all physicians providing care to children with asthma, and we assess whether care fragmentation would limit the ability of physicians receiving reminders to contact and alter the care of their patients.

The study used 1993-1995 Medicaid claims data from the states of Alabama (acquired directly from the state) and Michigan (acquired from the Health Care Financing Administration's research files) to identify two cohorts of children, ages 2-13 years, treated for asthma, who were continuously enrolled during the year. We included in the cohort children who had received at least one asthma diagnosis (ICD9 code 493) recorded on a claim for a medical encounter during the year. We also included children who had not received an actual asthma diagnosis, but who had claims for medical encounters on three separate days during the identification year which represented asthma-like symptoms. For the study of medication and health care utilization, we concentrated our analysis on the cohort of children with asthma in each state identified in 1994, following their utilization experiences in 1995. This time lag was built in so that we would be more likely to be assessing utilization after the usual treatment pattern for the condition in this child had been established. The entire cohort of children with asthma in 1994 who remained continuously enrolled in Medicaid through 1995 included 2554 children in Alabama and 8634 children in Michigan. The base population of children who were continuously enrolled through 1994 and 1995 was 78,658 in Alabama and 222,031 in Michigan, yielding a treated asthma prevalence rate of 3.2% in Alabama and 3.9% in Michigan for this study cohort.

Claims filed for prescription drugs were used to identify four aspects of medication treatment for asthma which are problematic relative to the NAEP asthma treatment guidelines that were current at the time. The first problem was the occurrence of a time period when an active prescription for a beta-agonist, a treatment for the acute symptoms of asthma, was not available to a child with asthma. Availability was assessed based on the timing of filled and refilled prescriptions. The second problem occurred if a child over age six had a claim for the oral form of this medication, since guidelines advise use of the inhaled form as more effective and usable by this age group.

The third problem we identified was limited to children classified as having more severe asthma, defined based on previous utilization of urgent care or preventive asthma medications. The occurrence of a time period without an active prescription for a preventive medication, either inhaled cromolyn sodium, inhaled corticosteroids or oral theophylline, was considered to be a problem for children with more severe asthma.

Finally, previous research using Alabama Medicaid data had indicated that some children with asthma diagnoses occasionally filled prescriptions for narcotic cough medications. We considered this to be a treatment problem, since such medication suppresses respiratory response, and could be dangerous for a child with reactive airway disease. In the course of conducting this study we found that the Michigan Medicaid program does not provide coverage for narcotic cough medicines. Thus analysis of the occurrence of this problem is limited to Alabama.

Our major findings on compliance with asthma medication regimes were as follows:

- Medication costs accounted for nearly one third of expenditures on asthma for children ages 2-13 covered by Medicaid in Michigan and Alabama in 1995.
- Prescriptions for medications for the treatment of acute symptoms of asthma were filled by about 85% of the children with asthma in each state, while prescriptions for medications for the prevention of asthma exacerbations, were filled by about 43% of children in both states, including 81% of those with moderate or severe asthma.
- Only about 14% of those with mild asthma and 7% of those with severe asthma maintain active prescriptions for appropriate medications over the course of the whole year.
- Urgent ambulatory or inpatient care was used by 13% (Michigan) to 17% (Alabama) of the population during 1995, and was more commonly used by children with greater expenditures and more availability of medications than by other children with asthma.
- Providing the recommended amount of asthma medication coverage all year for all children in these Medicaid cohorts would increase total expenditures for children with mild asthma by about one-third, and would nearly double current expenditures for children with moderate or

severe asthma. These additional expenditures could not be recouped by decreases in urgent care use for these children, since the additional expenditures are larger than the current amounts spent on such care.

- Efforts to provide care for children with asthma covered by Medicaid that meet the current recommendations for asthma treatment will require the investment of additional funds and cannot be expected to generate large dollar savings. Based on current practice recommendations, however, they can be expected to improve the functional status of these children.

- Several characteristics of children and aspects of their care use were predictive of gaps in medication availability. Children were less likely to have gaps in medication availability if they had more severe asthma, if they were frequent users of asthma ambulatory care, and if their most recent asthma visit was specifically coded with the diagnosis of asthma on the claim. Children eligible for Medicaid because they received Supplemental Social Security for some other form of disability were also less likely to have gaps in asthma medication availability.

- Ambulatory care in outpatient hospital settings, urgent care and inpatient care were all associated with later gaps in medication availability. These findings all reinforce a standard assumption of asthma care, which is that care provided in urgent-oriented settings is not conducive to on-going, appropriate, prevention-oriented treatment of the condition.

- Children who saw the same physician throughout 1995 were also more likely to have gaps in medication availability than those who saw more physicians. This may represent the absence of a referral to a specialist for these children, but it also suggests that some physicians may not be familiar with current standard treatments for asthma.

- Use of hospital based care, urgent care and no care at all were more common for black and other urban children than for white and rural children in both states. Controlling for these factors, and also for asthma severity and diagnostic accuracy, we found that black children and those living in urban areas were actually less likely than other children to have gaps in medication availability. They were also less likely to fill prescriptions for narcotic cough medications. This suggests that the treatment deficiencies often reported for these children are more a function of the care systems they use than specifically a function of their demographic characteristics.

- At the same time, there were some indications that the black and other children in our cohorts, who were those who sought care for asthma in 1994, had more severe manifestations of the condition than white children. Prevalence rates among Medicaid eligibles were lower for this group, average severity rates were higher and fewer of them returned for care in 1995. This suggests that there may be more black and other children than white children covered by Medicaid who have symptoms of relatively mild asthma, but who do not receive the benefits of asthma medications and routine care.

Our major findings on the correspondence between Medicaid claims and medical record data were as follows:

- Much of the data that would be needed for assessments of asthma severity or encounter urgency was not actually documented in the medical records we reviewed.

- The small set of data elements available in claims data for use in measuring asthma urgency and severity are actually measures of service utilization, rather than measures of health status. The claims data elements identify urgent asthma encounters accurately, but they do not identify all of the urgent asthma encounters that actually occurred for this population, because Medicaid claims were not submitted for every instance of nebulized medication provision reported in the medical records. Thus claims data present an accurate picture of the content of care for some encounters, but do not identify the extent to which a type of care occurs in the population.

- Children in this population with claims for asthma generally do have asthma, according to their medical records. Accuracy of case finding is with claims is enhanced when the broader diagnostic category of asthma-like respiratory diagnoses is used, and when claims for an entire period of time, rather than just a single encounter, are considered.

- Comparison of medical records and claims showed that 60% of documented asthma prescriptions were filled within one week and 30% were never filled. Further we found that about 37% of filled asthma prescriptions were undocumented in medical records. Thus in a sense, claims data are a better measure of medication availability than medical records. However, it is a mistake to conclude that the absence of a claim for an appropriate asthma medication or the absence of medical records documentation indicates a prescribing failure on the part of the physician.

- We conclude that claims-based content of care indicators are useful for identifying a range of quality problems, including absence of appropriate medications, failure to accurately diagnose the condition and failure to provide follow-up care after urgent episodes. Claims based data do not identify every case of these problems that occurs. It is not possible to ascertain from claims data whether the quality problem is do to provider actions, documentation problems or to the actions of asthma patients and their families.

Our major findings from the simulation of a letter reminder system using claims data were as follows:

- Problem care, as defined here and identified using administrative data, is quite common for children with asthma covered by Medicaid, affecting over one half of all children seen in one month, in both Alabama and Michigan. The physicians providing problem care to these children include over half of the physicians providing care in the sample month in both Alabama and Michigan. Thus, it is not the case that problem asthma care is an isolated phenomenon, for either patients or physicians.

- In both states, over 70% of the physicians associated with problem care were treating patients they had seen before, and over 70% of these physicians see these same patients again. Of all the children, new and established patients, who are seen by these physicians in one month, over half are seen again during the course of the year. Thus it is not the case that most children with problem asthma care lose touch with their physicians over time.

- Under these circumstances, a letter reminder system could have a relatively large affect on the care of children with asthma, providing the message was clear and recommended actions which physicians could realistically accomplish. Claims data could be used to provide physicians with a history of the times that children had been seen for asthma-like symptoms in the past, thus supplementing patient histories which may or may not have been taken by physicians, and may not be accurate. Claims data could also inform physicians about whether families filled prescriptions that were written after the child received care. Such information could be used by physicians as a reference, if and when a child returned for care, but preferably the information would be used to reach out to families and encourage them to be seen for routine, prevention oriented asthma care.

INTRODUCTION

BACKGROUND: COMPLIANCE WITH ASTHMA CARE RECOMMENDATIONS

Childhood asthma imposes a heavy burden on health care resources and on families. It causes more school absenteeism and limited activity than any other chronic illness in childhood (Friday and Fireman 1988, Gergen et al 1988, Newacheck et al 1986). Using 1985 data, Weiss, Gergen, and Hodgson (1992) estimated the direct medical costs of asthma, excluding medication costs, for US children under age 18 years at $465.1 million per year. In their analysis, medication costs for adults and children together accounted for nearly 30% of all direct costs. Indirect costs were valued at an additional $825.1 million. At a time when hospitalization rates for most childhood illnesses declined, the hospitalization rate for asthma increased (Gergen and Weiss 1990, Mullally et al 1984). Data from the National Health Interview Survey show a 33% increase in the prevalence of childhood asthma from 1981 to 1988 (Taylor and Newacheck 1992). In addition to disease prevalence and hospital utilization, mortality rates for asthma have been increasing, particularly among urban, poor and minority individuals (Lang and Polansky 1994, Weiss and Wagener 1990).

Low income children use more urgent care for asthma than other populations. In an Interim Report to Congress in 1992, HCFA reported that pediatric asthma was the highest volume non-pregnancy related condition treated on an inpatient basis in the non-elderly Medicaid population, accounting for 12% of these admissions. The Report estimated that admission rates for pediatric asthma were 75% higher in the Medicaid population than in the non-Medicaid population (HCFA Office of Research, 1992, page 3-14). Halfon and Newacheck (1993) compared poor children with asthma to non-poor children with asthma and found poor children had fewer doctor visits, had more and longer hospitalizations, and were much more likely to use an Emergency Department whenever they were sick. Wissow et al (1988) found asthma hospitalization rates were much higher for Medicaid-enrolled children than for children whose care was paid for by other sources. Murray, Stang and Tierney (1997) and Lozano, McConnell and Koepsell (1995) both report that inner city African American children use more care in urgent ambulatory and inpatient settings than white children, while Ali and Osberg (1998) report very low rates of follow-up visits after hospitalizations for asthma among low income children. In addition, Bosco, Gerstman, and Tomita (1993) reported that many children with asthma in the Michigan Medicaid population from 1980 to 1986 failed to receive effective drugs, and many received a type of medication then listed by the FDA as lacking substantial evidence of effectiveness.

In 1990-91, the Coordinating Committee of the National Asthma Education Program (NAEP) convened an expert panel to develop guidelines for the diagnosis and management of asthma. They stated "With appropriate therapy, patients with asthma can expect to control their symptoms, prevent most acute exacerbations, maintain the activity levels they desire, and attain near normal lung function" (NHLBI 1991). The 1991 NAEP expert panel report was part of an effort to "bridge the gap between research and practice" in asthma care, and was widely distributed among physicians. This work was updated in 1997 (NHLBI 1997).

The first purpose of this study was to examine whether medication regimes for children covered by Medicaid are in compliance with the recommendations made by the NAEP. Using Medicaid claims, we examined the experience of two states, Alabama and Michigan, in part to assess the generalizability of our observations concerning medication utilization. In addition, the Alabama Medicaid program covers a significant number of African American children living in rural areas, while Michigan's African American Medicaid population for the most part resides in urban areas. The differing demographics in the two states allowed us to assess whether the observations made in other studies concerning care utilization among African American children with asthma are really only characteristic of the care in large urban areas. We also assessed whether features of a child's health care utilization were associated with compliance or non-compliance with medication regimes. In addition, we examined expenditures on different types of asthma care in the two states, and explored whether expenditures on medications substitute for expenditures on urgent or routine medical care.

BACKGROUND: VALIDATION OF CLAIMS DATA

One approach to monitoring medication use and other aspects of health care quality is a focused study, which examines medical records and other primary documentation for a sub-sample of the population to assess whether appropriate care for a condition is being provided. The Health Care Financing Administration's Quality Assurance Reform Initiative (QUARI) project, which adapted quality of care principles and practices for use with Medicaid managed care, recommended that focused studies of quality of care for children with asthma be used to evaluate the quality of care provided by managed care organizations serving this population (NCQA 1994).

An alternative to medical records studies for assessing the quality of medical care provided to the population is the use of administrative data, such as that provided by insurance claims. The strengths of administrative data compared to medical records data are that they can be used to review the care provided by multiple entities to the same individuals, and to review care across an entire population, rather than a sub-sample (Scholle et al 1996). Administrative data are also faster and less costly to collect and examine than medical record data (Weiner et al 1990, Parente et al 1995, Steinberg et al 1990). The major weaknesses of the use of administrative data for examining quality of care are the absence of clinical detail about the nature of the medical problem and uncertainty about the accuracy of claims data in describing the content of medical care encounters (Steinberg et al 1990, Iezzoni et al 1998). In the case of medication monitoring, prescriptions that are written by physicians but not filled by patients do not generate administrative records. In that case, administrative data may be a useful measure of gaps in medication treatment (Steiner and Prochazka 1997, Ray and Griffen 1989), but not a good measure of the content of care provided by physicians. At the same time, the medical records data used for focused studies themselves do not always include the desirable information about the clinical problem and the nature of treatment (Stange et al 1998).

The second purpose of this study was to assess the accuracy of Medicaid claims data for identifying problems in the pharmaceutical treatment of asthma by comparing claims data to medical record data. We selected a small sample of children in Alabama with asthma in 1995, and requested full year ambulatory and inpatient records from all of the physicians and hospitals who filed claims on behalf of these children for the time period extending from January 1, 1994 to March 31, 1995. The records, bearing only study identification numbers, were submitted to the Alabama Quality Assurance Foundation (the state's Physician Review Organization) for abstraction. We compared selected elements from the abstracted record to corresponding Medicaid claims filed for care on the same date, or, in the case of medications, for twelve months following the date of care. We report here the extent to which conclusions about the content of a child's care imputed from Medicaid claims correspond to conclusions reached based on medical record review. We pay particular attention to whether claims filed for prescription medications reflect prescriptions recorded in medical records.

BACKGOUND: EFFECTIVENESS OF REMINDER SYSTEMS

By definition, drug utilization review is a systematic process for reviewing patterns of medication use for a population against predetermined standards and for remediating any problems identified in such reviews (Lipton and Bird 1993). If deviations from recommended pharmaceutical treatment for asthma are widespread, and if improved pharmaceutical treatment can reduce the expensive and disruptive use of urgent ambulatory and inpatient care for asthma, then this condition should be a prime target for drug utilization review. This is particularly the case for Medicaid programs, since pediatric asthma is a costly condition for this third party payer, and since Medicaid is mandated by the 1990 Medicaid Rebate Law to conduct both retrospective and prospective DUR using explicit criteria. In principle, DUR programs have the potential to facilitate pharmaceutical improvements that improve the quality of life and lower total costs of care for all children with asthma.

Recent HCFA funded studies have assessed the potential for prospective DUR, including information systems for pharmacies, patient education and cognitive services provided by pharmacists, for improving the outcomes of pharmaceutical treatment in general and specifically for children with asthma (HCFA Cooperative Agreements with the states of Iowa and Washington, evaluations of these projects by Abt, Associates and an AHCPR funded project at the University of Washington). However no studies so far have reported the application of retrospective DUR to this condition (Moore 1993, personal communication, J.Searcy, M.D., Medical Director, Alabama Medicaid Agency). Retrospective DUR involves the notification of care providers about problems in pharmaceutical care that have already been provided to patients, in the hopes that these medication problems can be corrected and that the physician will avoid similar problems in the future. Retrospective DUR is in many ways a less costly and more flexible system to put in place than prospective DUR.

Several recent reviews of the state of the art in drug utilization review (Jones 1991, Lipton and Bird 1991, 1993, Soumerai et al 1993, Moore 1993) suggest why asthma has so far not been included in retrospective DUR systems. These reviews note that retrospective DUR systems have tended to focus on detecting undesirable drug combinations, the use of drugs with adverse reactions, therapeutic duplications and the use of expensive drugs when less expensive, equally effective drugs can be used. They have not been focused on issues of undermedication or inappropriate medication, and they are rarely able to detect patient noncompliance with medication therapy.

In part this choice of focus for retrospective DUR has occurred because explicit criteria are easier to devise for detecting drug interactions, duplications, and price-based substitutions problems in computerized data; less involvement is required by multi-specialized clinical teams and there is less need to rely on the diagnostic data recorded in administrative records. In addition this choice of focus has occurred because resolving these types of prescribing problems can yield immediate cost savings on drug expenditures. Resolving more complex problems such as under-medication can produce higher short term expenditures, while potential savings in downstream medical costs are much more difficult to document. It is difficult to justify the creation of a retrospective DUR system for a medication problem when the extent and nature of the prescribing problems are not known, and when the potential monetary and health status impact of reducing the problem cannot be realistically estimated. Finally, as the evaluation of California Medicaid's retrospective claims-based DUR suggested, the impact of reminder letters based on past problems to alter future outcomes related to medication problems may be limited if care for a condition is characterized by the fragmentation of a child's medical care across providers, the dispersion of patients across providers and time lags between the prescribing event and the receipt of the notification letter (Jay et al 1991).

The third purpose of this study was to use claims data to simulate a letter reminder system that would notify physicians if claims data indicated deficiencies in medications and other types of car provided to children with asthma. We examined whether the physicians associated with care problems are a small or large segment of all physicians providing care to children with asthma, and we assessed whether care fragmentation would limit the ability of physicians receiving reminders to contact and alter the care of their patients.

DISCUSSION

METHODOLOGICAL APPROACH

IDENTIFICATION OF COHORTS WITH ASTHMA

We used 1993-1995 adjudicated Medicaid claims data from the states of Alabama (acquired directly from the state) and Michigan (acquired from the Health Care Financing Administration's research files) to identify two cohorts of children, ages 2-13 years, treated for asthma, who were continuously enrolled during the year. We included in the cohort children who had received at least one asthma diagnosis (ICD9 code 493) recorded on a claim for a medical event (visit or admission) during the year. We also included children who had not received an actual asthma diagnosis, but who had claims for medical encounters on three separate days during each year which represented asthma-like symptoms. These included codes for unspecified bronchitis (ICD9 490), chronic bronchitis (ICD9 491), acute exacerbation of chronic bronchitis (ICD9 466.0), bronchitis or bronchiolitis (ICD9 466), bronchiolitis (ICD9 466.1), wheezing (ICD9 786.09), cough (ICD9 786.02), chronic airway obstruction (ICD9 496), and emphysema (ICD9 492). Children diagnosed with cystic fibrosis or trachemalacia were excluded from the cohorts. We included children with asthma-like diagnoses as well as those diagnosed with asthma because our previous research with Medicaid claims indicated that use of these diagnoses for children who had previously been diagnosed with asthma itself is relatively common, occurring in 13% of all asthma and asthma-like encounters. Appendix A describes the sensitivity testing we conducted with earlier years of Alabama Medicaid claims data before selecting to include three visits for asthma-like conditions in our definition of cohorts with asthma.

Table 1 shows the size of the cohort and the prevalence of asthma in each year in each state.

Table 1 Prevalence of Asthma in Children Ages 2-13 Years of Age, 1993-1995

Cohort	Alabama			Michigan		
	1993	1994	1995	1993	1994	1995
Enrolled	118,262	105,153	108,503	273,413	281,656	285,355
Asthma Diagnosis	2216	2757	3423	10,183	9239	8982
3 + Asthma-like Visits	364	489	587	2110	1422	1578
Total Cohort	2580	3246	4010	12,293	10,661	10560
Prevalence per Hundred	2.27	3.09	3.70	4.50	3.79	3.70

These prevalence rates are on the low end of the reported range for asthma prevalence in children, which are generally reported to be between 3% and 7% of the population (Gergen, Mullally and Evans 1988). They undoubtedly under-represent the actual prevalence of asthma in this population, since they only include children who sought medical treatment for respiratory symptoms and were diagnosed with asthma or asthma-like conditions. The portion of children included in the cohort with asthma-like symptoms is quite consistent across years and states, ranging from 13% to 17% of the cohorts.

CHARACTERISTICS OF THE CHORTS

In order to examine medication and health care utilization for children with asthma, we used claims data to characterize asthma severity, medication use and characteristics of utilization. We found that 1993 claims data for Michigan coded medication claims using state specific drug codes, rather than the National Druge Code (NDC) system. We were thus unable to characterize disease severity in the previous year for the 1994 Michigan cohort. We therefore concentrated our analysis on the cohort of children with asthma in each state identified in 1994, following their utilization experiences in 1995. This time lag was built in so that we would be more likely to be assessing utilization after the usual treatment pattern for the condition in this child had been established. The entire cohort of children with asthma in 1994 who remained continuously enrolled in Medicaid through 1995 included 2554 children in Alabama and 8634 children in Michigan. The base population of children who were continuously enrolled through 1994 and 1995 was 78,658 in Alabama and 222,031 in Michigan, yielding a treated asthma prevalence rate of 3.2% in Alabama and 3.9% in Michigan for this study cohort.

Asthma severity- Medication use, care utilization and expenditures for asthma are closely related to the severity of the disease in a given individual (Serra-Battles et al 1998), but the self reports and lung function measures typically used to measure asthma severity are not available on claims data. We developed an indicator for asthma severity based on the 1991 NAEP guidelines for severity classification that could be applied to administrative data. Children were considered to have moderate to severe asthma if they had more than one urgent ambulatory visit or inpatient admission or if they had a filled prescription for one or more of the preventive asthma medications. We included the use of preventive medications as an indicator of severe asthma in order to avoid confounding children whose severe asthma is well controlled by medication with children who have mild asthma (Cockroft and Swystun 1996). Urgent ambulatory visits were defined as those that included a claim for a nebulizer treatment (CPT codes 94640, 94650, 94651, 94664 and 94665), which is a procedure for treating acute asthma exacerbations with aerosolized medications. We considered urgent ambulatory visits and inpatient admissions together for the purposes of describing asthma severity, because hospital admission thresholds for asthma vary geographically and have changed over time (Vollmer et al). Preventive asthma medications were defined as prescriptions for oral theophylline, inhaled corticosteroids and cromolyn sodium, as recorded using NDC codes on claims. Appendix B describes the sensitivity testing we conducted with earlier years of Alabama Medicaid claims data before selecting the combination of urgent visits and preventive medication use used to categorize asthma severity. It should be noted that this approach relies on utilization data to measure clinical events. Children who do not seek treatment for asthma exacerbations and do not receive preventive medications are misclassified as having mild asthma using this approach.

Medication regimes- Claims filed for prescription drugs were used to identify four aspects of medication treatment for asthma which are problematic relative to NAEP asthma treatment guidelines. The first two are related to the NAEP guideline that states that children with asthma should have a medication available at all times to treat the acute symptoms of asthma when they arise. We classified all medications used for this purpose as beta-agonists, and distinguished between the oral and the inhaled form of the medication. We assumed that a beta-agonist would be available for six months after the date a prescription was filled; sensitivity testing showed no difference between this assumption and the assumption of a longer period of availability. The first problem we identified was the occurrence of a time period when an active prescription for a beta-agonist was not available to a child with asthma. The second problem we identified was when a child over six years of age had a prescription for the oral form of this medication, when guidelines advise use of the inhaled form as more effective and usable by this age group.

The third problem we identified was limited to children classified as having moderate or severe asthma, by the criteria above. NAEP guidelines indicate that such children should be receiving a regime of preventive asthma medications, including some combination of oral theophylline, inhaled corticosteroids and cromolyn sodium. We assumed that inhaled cromolyn and corticosteroids remained available for 84 days after the prescriptions were filled, while oral theophylline was available for 49 days after the prescriptions were filled. We assumed that all oral theophylline was used for preventive purposes, although this medication is sometimes used on an acute care basis. The occurrence of a time period without an active prescription for a preventive medication was considered to be a problem for children with moderate or severe asthma.

Finally, previous research using Alabama Medicaid data had indicated that some children with asthma diagnoses occasionally filled prescriptions for narcotic cough medications. We considered this to be a treatment problem, since such medication suppresses respiratory response, and could be dangerous for a child with reactive airway disease. In the course of conducting this study we found that the Michigan Medicaid program does not provide coverage for narcotic cough medicines. Thus analysis of the occurrence of this problem is limited to Alabama.

Demographic Characteristics- Data on children's race, age, eligibility status for Medicaid were compiled from the Medicaid administrative data in the two states. We dichotomized race into two categories, White and All Other; in both states the All Other group is over 90% African American. We categorized eligibility in one of three groups:

- AFDC eligible, which includes the lowest income groups (in 1996 these levels were 15% of the federal poverty level in Alabama and 45% of the federal poverty level in Michigan, (King and Christian 1996)).
- Disabled, which includes children who qualify for Medicaid through a disability and may also receive disability payments through the Social Security system. Some children with severe asthma qualify for Medicaid eligibility on this basis.
- Poverty eligible, which includes both foster children and children who were not welfare-eligible in 1995 but who had family incomes below the state specified threshold (133% of the federal poverty level in Alabama and

185% of the federal poverty level in Michigan, (King and Christian 1996)).

We also used the county of residence to identify whether a child lived in an urban (in a metropolitan statistical area (MSA)) or rural (non-MSA) county.

Care Characteristics

We summarized the 1995 Medicaid claims with asthma and asthma-like diagnoses in order to characterize types of asthma care used. We flagged encounters with asthma-like diagnoses in order to examine whether failure to actually use the diagnosis of asthma was related to other types of care provided to patients.

Our site of care measures were limited to those adequately coded on the claims data. Thus we were able to assess use of hospital outpatient or emergency departments, physician offices, clinics and inpatient settings, but, due to missing information in the Michigan claims data, were unable to distinguish among physicians by specialty. As noted above, we designated urgent ambulatory visits as those that included a claim for a nebulizer treatment, and inpatient admissions as encounters coded as occurring in inpatient settings.

We used unique provider identification numbers on the claims data to count the number of different providers used by children receiving care. We also constructed a measure of physician continuity based on the Herfindahl index, which indicates, in a range from 0 to 1, the degree of concentration of each child's care with a single provider. We found that the median number of respiratory visits for the cohort in 1995 was two, and we defined all of those with more than two visits per year to be frequent care users.

Expenditures for asthma- The expenditures reported here are based on the amounts that the Medicaid programs in the two states paid in 1995 to the providers filing claims for treatment of asthma for children in these cohorts. Each Medicaid program uses its own fee structure to reimburse providers for services. Fee levels vary across states depending both on the prevailing prices in market areas of the state and on policy decisions made within the state concerning funds available and the need to set fees high enough to attract an adequate number of providers to serve Medicaid clientele. The Physician Payment Review Commission (PPRC 1994) reported average new patient office visit levels within Medicaid in 1993 to be $24.75 in Alabama and $35.89 in Michigan. However, average fee levels in Alabama were reported to be 76%-86% of average local Medicare fee levels, while fee levels in Michigan were 69% of local Medicare fee levels. Thus we should expect that per patient expenditures will be somewhat higher in Michigan than in Alabama, although Michigan fees are more discounted from local prevailing prices than fees in Alabama.

MEDICAL RECORDS DATA

For the claims validation component of the study, we identified a small sample of 98 children from the 1994 Alabama cohort who had received care for asthma or an asthma-like respiratory problem between January and March of 1995. All of the medication problems described above were represented in this sample. We compiled the Medicaid claims filed for treating these children from calendar year 1994 through March of 1995 and identified the unique providers seen by each child. We identified a total of 411 providers who had filed claims for the 98 patients in our sample. Each child saw an average of 5 unique providers in a 12 month period, with a minimum of one and a maximum of 18 providers seen.

Using statewide listings of physicians and other resources, we consolidated the listing so that single letters could be sent to physicians in group practices. We sent request letters to 271 total contacts. Follow-up requests were sent to non-responding physicians and institutions. Physicians and institutions were asked to send in copies of all records generated between January 1, 1994 and March 31, 1995, excluding laboratory and radiology findings. Physicians and institutions were informed that their participation in the study was voluntary, and that the data would be recorded anonymously, with no retention of patient or physician names. Overall we received records from 55% of the providers we contacted. Table 2 displays the results of the medical record collection effort.

Table 2 Response Rates for Medical Record Collection

Provider type and specialty	Providers contacted	Records Received	No Record Available (practice closed)	Returned	Refused	No Response
Inpatient	10	8 (80%)	–	–	–	2
Out-patient	46	32 (70%)	8	–	2	4
Pediatricians	45	28 (62%)	–	3	2	14
General, Family MDs	57	33 (58%)	1	3	2	18
Pulmonology - Allergy	6	1 (17%)	–	–	–	5
Other MD	46	22 (49%)	2	3	3	16
Health Depts	26	18 (60%)	1	2	2	3
Drugs Only - No Medical Encounter	35	7 (20%)	7	2	2	17
Overall	271 (100%)	149 (55%)	19 (7%)	13 (5%)	13 (5%)	79 (29%)

This response rate is strong for a voluntary effort, exceeding the 30% response rate reported by Fowles et al (1995) for a voluntary effort to collect ambulatory medical records for Medicare patients in Maryland. However, it is clear that there is some bias in terms of the records that were available for analysis. In particular, we had only one response from a pulmonary or allergy specialist. We also had a low response from physicians whose provider numbers were recorded on prescriptions but who had filed no other claim for services, shown as "Drugs Only - No Medical Encounter", in Table 2. Also, as noted, we had to contact several different providers to collect records for the same patients. Even taking into account that some physician records represented encounters for which hospital records were also available, we were able to collect a totally complete series of medical records for only 32 of the 98 patients in the sample.

The medical records we received were abstracted by the Alabama Quality Assurance Foundation, which also serves as the Medicare Professional Review Organization for the State of Alabama. We designed the abstracting protocol, which recorded details of the patients' medical history relative to respiratory problems, the nature of the current complaint, medication history, treatments provided and medications prescribed, based on documentation in the record. Abstractors were asked to designate a visit as "urgent" if the visit appeared to be prompted by acute symptoms, and to designate asthma as "severe" based on physicians' designation. Each inpatient hospitalization and each individual ambulatory encounter was abstracted as a separate record. An on-going, 5 percent re-abstraction of the records was conducted to assure inter-rater reliability.

We then matched each of these medical records to the Medicaid claim that was presumably submitted for reimbursement of the encounter. Claims and medical records were considered to match if they were recorded for the same patient and the same provider on the same date. The 98 children in our sample had a total of 920 separate events during 1994 for which a Medicaid claim was filed by a health care provider. Claims filed for medication only are not included in this count. Our medical record data collection effort yielded a total of 646 abstracted encounters. As shown in Table 3, medical records were available for 50% of the claims encounters. The majority of the claims with no matching record (315 of 460, or 68%) were filed by providers who did not respond to the record request. The remainder of the unmatched claims were submitted by responding providers, who either did not have records available for the patient in question, or submitted records with a different date than that recorded on the claim. We identified matching claims for 80% of the submitted records. Unmatched records may have had different dates than the submitted claims, or may have represented encounters for which no claim was filed, as is likely the case with the 46 phone consults.

Table 3 Portion of Medical Records Matched to Claims

Number of medical encounters based on claims	Number of claims encounters matched to medical records	Number of claims encounters with no matching record		Distribution of abstracted records (Total records = 646)			
		Respondents	Non-respondents	Matches Medical Claim	Matches Drug Claim	Phone Consult	Un-matched
920	460 (50%)	145 (16%)	315 (34%)	460 (71%)	46 (7%)	41 (6%)	99 (15%)

We conducted five analyses with the matched claims and records data in order to assess the extent of their correspondence and the extent to which conclusions reached from one data source would be validated with the other data source. First we assessed the availability of information on the medical records that could be used to measure the general severity of disease in this child and the urgency of this medical encounter. Second, we examined whether claims and records data recorded the same place of service and specialty of the provider, and agreed on the occurrence of administration of nebulized medication. Third, we examined whether the diagnosis recorded on the Medicaid claim matched the diagnosis recorded on the record. Fourth, we examined whether pharmaceutical claims were filed for each of the medications recorded as prescribed in the medical record. Finally, for the small subset of children for whom a complete sequence of records were available, we examined whether claims filed for medications between January and March of 1995 were documented as having been prescribed in a medical record over the previous 12 months.

SIMULATION STUDY

We used Medicaid claims for January 1995 for the 1994 cohorts in the two states to identify three asthma care problems that may have occurred during the month: failure to provide a follow up office visit after urgent care for asthma, failure to diagnose asthma rather than describing respiratory symptoms, and failure to be sure that children seen for asthma or asthma-like symptoms have active prescriptions for appropriate medications. Our indicator for the absence of a follow up visit was the absence of a claim for an office visit within two weeks of a claim for an inpatient asthma admission or an urgent ambulatory asthma visit. Our indicator for failure to diagnose asthma was the use of one of the alternative diagnosis codes described above for the claim filed for a medical encounter, in place of the use of the diagnosis code for asthma. Our indicator for failure to be sure that children seen for asthma or asthma-like symptoms have active prescriptions for appropriate medications was lack of availability of appropriate medications, measured as described above, continuing for two weeks after a medical encounter for asthma.

We used these indicators to identify children who had these problems during medical encounters for asthma in January 1995, tracking also the occurrence of follow up visits from urgent ambulatory or inpatient care episodes occurring in late December 1994. We then identified the treating physicians whose actions or lack of actions were associated with the treatment problems. For the failure to provide an office based follow up visit, we identified all physicians billing for care during the inpatient or urgent ambulatory care episode. For the failure to diagnose asthma, we identified the physician who used the alternate coding on the claim submitted to Medicaid. For the failure to assure availability of appropriate medications, we identified the physicians who filed claims for the encounter (routine, urgent or inpatient) after which appropriate medication remained unavailable.

Finally, we used Medicaid claims data from 1994 and 1995 to generate the information needed to model the potential effectiveness of reminder letters under different assumptions. We assessed whether the child whose treatment would have triggered the reminder letter to the physician was an established patient of that physician by assessing whether the physician had treated (i.e., filed a Medicaid claim on behalf of) the child in the previous twelve months. We assumed that letters concerning the treatment that children received in January would be unlikely to reach physicians before March, and we assessed how many of the children whose treatment in January triggered the reminder letter were seen by the same physician between March and December 1995. We also applied our three indicators of problematic asthma care to the March through December 1995 claims for the entire 1994 cohorts with asthma, to assess the number of children with poor care who could potentially be affected by improvements in the treatment of asthma by providers who would have received reminder letters.

DISCUSSION

FINDINGS: MEDICATION AND CARE UTILIZATION

ASTHMA PREVALENCE AND MEDICATION PROBLEMS BY POPULATION SUBGROUPS

Table 4 shows the prevalence rates of diagnosed asthma and the portion of children classified as having severe asthma across population groups.

Table 4 Portion of Continuously Enrolled Children with Asthma, 1994

Group	N Enrollees	N Cases	Rate of Asthma	% with Severe Asthma
Alabama	78,658	2554	3.25	32.9
Rural White	10,068	437	4.34	32.2
Rural All Other	20,513	700	3.41	26.3
Urban White	12,975	527	4.06	34.3
Urban All Other	35,102	890	2.53	37.6
Michigan	222,031	8634	3.88	33.1
Rural White	27,841	1436	5.16	31.0
Rural All Other	2,523	157	6.22	40.7
Urban White	67,481	3114	4.61	33.0
Urban All Other	124,186	3927	3.16	33.7

Although the urban black population is generally thought to have a higher prevalence of asthma than other groups, Table 4 shows that their rate of diagnosed cases is actually lower than that of other groups in both Michigan and Alabama. However, severity rates tend to be higher in this group. One explanation for these findings is that there may be a higher threshold for seeking medical care for respiratory problems in the black urban population. This would explain why diagnosed rates are lower but why cases were more likely to be severe in this population.

Table 5 shows the portion of children in each group in Alabama and Michigan with each of the four asthma medication problems described above.

Table 5 Portion of Children with Asthma Experiencing Medication Problems in 1995

Group	% with Gaps in Beta Agonist Availability	% with Oral instead of inhaled Beta Agonist (Over age 6, with any Beta Agonist)	% with Gaps in Preventive Medication Availability (Severe cases only)	% with Narcotic Cough Medication Prescription Filled
Alabama	82.0	36.3	92.7	31.5
Rural White	84.2	37.6	90.8	44.6
Rural All Other	86.1	39.9	94.6	29.9
Urban White	83.7	32.4	88.9	29.8
Urban All Other	76.7	35.5	94.7	27.6
Michigan	84.3	28.2	92.3	
Rural White	84.9	20.9	89.0	----
Rural All Other	76.4	15.8	81.2	----
Urban White	85.3	29.2	92.4	----
Urban All Other	83.6	30.7	93.9	----

Table 5 shows that medication problems for children with asthma covered by Medicaid are relatively common and similar in both Alabama and Michigan. Differences between rural and urban children, and between white and black children are not particularly dramatic. However, in both states, black children are less likely to have gaps in Beta Agonist availability. In Alabama and in urban areas of Michigan, however, black children are more likely to have gaps in availability of preventive medications. Use of narcoticss occurs less often for black children in Alabama.

CARE UTILIZATION BY POPULATION SUBGROUPS

As noted above, each cohort was diagnosed with asthma or asthma-like conditions during 1994. Care use was examined during 1995. Of the 1994 cohort, 42.6% in Alabama and 44.1% in Michigan had no medical encounters (that is, had no Medicaid physician or hospital claims filed) for asthma or asthma like conditions during 1995. About one third of these children without provider claims in each state did fill prescriptions for asthma medications, however. Table 6 shows the rate of selected care utilization patterns during 1995 across groups.

Table 6 Care Utilization Patterns Across Groups

Group	% Using Care	Of Care Users, % with Asthma-like DX for visit	Of Care Users, % with Office MD Visit	Of Care Users, % with Urgent Amb. Visit	Of Care Users, % with Hospital-ization	Of Care Users % with Multiple Providers
Alabama	57.4	57.1	75.2	16.2	6.6	42.7
Rural White	62.7	73.0	79.2	10.8	6.6	42.3
Rural All Other	52.7	59.1	74.3	16.8	7.3	38.3
Urban White	61.5	66.7	81.8	14.5	5.9	42.6
Urban All Other	56.0	40.6	69.7	19.9	6.4	45.8
Michigan	55.8	57.1	73.6	9.7	6.2	40.2
Rural White	57.0	59.0	74.8	4.8	2.0	37.7
Rural All Other	58.6	46.7	58.7	12.0	7.6	51.1
Urban White	54.6	61.7	83.6	10.0	3.4	36.5
Urban All Other	53.6	47.8	65.7	11.3	10.0	43.7

This table shows that black and other children relative to white children in Alabama and urban residents relative to rural residents in Michigan were less likely to return for care for asthma in 1995. When they did return, however, black and other children in both states were more likely to have visits with an actual asthma diagnosis, rather than a symptomatic or general respiratory diagnosis. Black and other children in the rural and urban areas of both states were more likely to have an urgent ambulatory visit (that is one which included an aerosol nebulizer treatment) and to be hospitalized than white children. All of these findings are consistent with the premise that black and other children, particularly in urban areas, had a higher threshold of seeking care for asthma problems, and thus probably had more severe problems when they were seen. Black and other urban children in Alabama and black and other rural and urban children in Michigan were all more likely to see multiple providers over the year for the care of asthma and asthma-like conditions than were white children, and were also less likely to see office-based providers. This suggests that care fragmentation and access problems, or possibly a tendency to seek care episodically, add to the asthma severity problem for these children, in comparison to others in the cohort. Again, the table shows that, with the exception of urgent ambulatory care use, utilization patterns were strikingly similar in the two states, despite the different demographic composition of the covered population.

ASSOCIATION OF CARE USE WITH MEDICATION PROBLEMS

In order to model the relationship between sites of care and occurrence of different types of medication problems we created a data file with one record for each child with asthma for each day in 1995. Using the Medicaid prescription drug claims file and our assumptions about medication availability, we identified whether or not a medication problem, such as the absence of a beta-agonist or a preventive medication, occurred on each day. In addition, for each child-day we described the characteristics of the last visit for care for asthma or an asthma-like problem, some of the characteristics of the preceding twelve months of care use and patient demographics. The severity of a child's asthma on that day is described based on the medication and urgent care use the child experienced in the twelve months immediately preceding that day. Thus severity of asthma could increase or decrease over the year, depending on the length of time that passed since the last urgent treatment or preventive medication prescription. We used logistic regression to assess the relationship between child and care characteristics and the presence of each of the medication problems on each day.

Table 7 shows these results of logistic regression models predicting the likelihood that one of four medication problems occurred on a given day for children in our two state cohorts. The state cohorts are combined here, as separate analysis indicated that the models did not differ between the states. It should be noted that the sample size for the first model, examining predictors of beta-agonist unavailability, is very large, since it includes 365 days per year for over 10,000 children. For this reason, we emphasize in the discussion only those odds ratios which are meaningfully different from one.

Table 7 Factors Associated with Medication Problems

Children Included	All Children	Children over age 6 with Beta Agonist	Children with More Severe Disease	All Alabama Children
Variables	Beta Agonist Not Available O.R. (95% C.I.)	Oral instead of Inhaled Beta Agonist Available O.R. (95% C.I.)	No Preventive Medication Available O.R. (95% C.I.)	Narcotic Cough Medicine Available O.R. (95% C.I.)
Features of Last Asthma Visit :				
Asthma DX vs Other Dx	0.44* (0.44, 0.44)	0.46* (0.42, 0.51)	0.63* (0.59, 0.66)	0.62* (0.56, 0.69)
In Clinic vs MD in office	1.02* (1.01, 1.04)	0.63* (0.55, 0.73)	1.03 (0.96, 1.11)	0.57* (0.48, 0.67)
In OPD Hosp vs MD in office	1.31* (1.30, 1.32)	0.85* (0.75, 0.96)	2.83* (2.59, 3.09)	0.82* (0.70,0.95)
No Asthma Amb Visit in Last Year vs MD in Office	2.52* (2.50, 2.54)	0.52* (0.43, 0.63)	2.33* (2.10, 2.57)	0.31* (0.25,0.39)
Urgent vs not urgent amb	0.88* (0.87, 0.90)	1.32* (1.01, 1.71)	16.84* (8.75, 32.41)	0.86 (0.69, 1.09)
Inpatient vs not urgent amb	1.75* (1.691, 1.814)	1.16 (0.663, 2.044)	0.801 (0.589, 1.091)	1.43 (0.923, 2.223)
Features of Past 12 Months of Care:				

Had High Frequency Use	0.54* (0.53, .54)	1.09 (0.98, 1.20)	0.41* (0.39, 0.43)	1.79* (1.60,2.00)
Provider Continuity Score	1.74* (1.72, 1.75)	1.27* (1.15, 1.40)	1.46* (1.38, 1.55)	0.86* (0.77, 0.96)
Child Characteristics:				
More Severe Asthma vs Not	0.25* (0.25, 0.25)	0.23* (0.21, 0.26)	-------------	1.09 (0.97, 1.22)
Under Age 6 vs not	0.99* (0.98, 0.99)	-------	1.71* (1.61, 1.82)	0.97 (0.87, 1.08)
All Other vs White	0.86* (0.86, 0.87)	1.17* (1.07, 1.28)	0.46* (0.43, 0.48)	0.85* (0.77, 0.94)
AFDC vs Poverty	1.04* (1.03, 1.05)	0.93 (0.84, 1.03)	0.98 (0.93, 1.04)	0.88* (0.79, 0.98)
SSI vs Poverty	0.90* (0.89, 0.91)	0.85* (0.75, 0.96)	0.73* (0.68, 0.78)	0.94 (0.82, 1.07)
Urban vs Rural Residence	0.94* (0.93, 0.94)	1.27* (1.14, 1.41)	0.77* (0.72, 0.82)	0.73* (0.66, 0.80)
Michigan vs Alabama	1.13* (1.13, 1.14)	0.70* (0.63, 0.77)	1.52* (1.44, 1.60)	————

*p < .05

Table 7 shows that there are several consistencies in the relationship between patterns of care use and problems in medication treatment for asthma. Children whose last visit for asthma care had the specific diagnosis of "asthma" recorded on the claim were less likely to have any of the medication problems we examined. Compared to having the last asthma visit occurring in a physicians' office, visits occurring in clinic or outpatient hospital settings were less likely to be associated with inappropriate forms of beta-agonist or with a filled prescription for a narcotic cough medication. However, children whose last respiratory visit occurred in an outpatient hospital setting were less likely to have an available beta-agonist or preventive medication. As would be expected, children with no asthma related visits in the last year were less likely to have available beta-agonist or preventive medication, but also less likely to have an inappropriate form of the beta-agonist or to have a filled prescription for a narcotic cough medication. Children whose last ambulatory visit was urgent (resulting in the administration of a nebulized medication) were more likely to have a beta-agonist available, but were much less likely to be on a regime of preventive medications. The beta-agonist they received, however, was likely to be in oral form, even if an inhaled form was more appropriate. Children whose last contact for asthma care was an inpatient hospitalization were less likely to have a filled prescription for a beta-agonist. Previous inpatient care for asthma was not associated with better availability of preventive medications.

Children with more than the median number of two visits in the previous twelve months were less likely to have gaps in availability of beta-agonist or preventive medications, although they were more likely to have a filled prescription for a narcotic cough medication. Children with high provider continuity were more likely to have all of the medication problems except a prescribed narcotic cough medication. Children with moderate or severe asthma were much less likely to be without a beta-agonist prescription.

Controlling for asthma severity and care use patterns, we find that both black and other children and urban-residing children are actually less likely to have gaps in availability of beta-agonists or preventive medications, and less likely to be receiving narcotic cough medications than white and rural-residing children. However, both groups were more likely to receive the oral form of the beta agonist. Poverty level made little difference in these medication problems, although the lowest income children (those on AFDC) were less likely to have narcotic cough medication prescriptions. Children qualified for Medicaid under disability payments were less likely to have asthma medication problems, possibly because they received specialized medical care for other problems. Controlling for care system and demographic factors, children in Michigan were more likely to have medication availability problems than children in Alabama, although they were more likely to have the appropriate form of beta agonist.

UTILIZATION AND EXPENDITURES ON ASTHMA CARE BY SERVICE

Of the 1994 Alabama cohort, 703 (27.5%) of the 2554 children used no care and filled no prescriptions for these conditions in 1995. Of the 1994 Michigan cohort, 2725 (31.6%) of the 8634 children used no care and filled no prescriptions for these conditions in 1995. Table 8 presents the overall mean cost of care and distribution of expenditures across service type in 1995 for the remaining children identified as having asthma in 1994 who were users of any care for asthma or asthma-like respiratory complaints. Table 8 also includes comparative data from published studies of the overall mean costs and distribution of costs for children with asthma.

Table 8 Comparison of Annual Mean Costs and Distribution of Service Types

	Current Study		Literature Comparisons		
Expenditure Distribution by Type of Service	Medicaid Enrollees, ages 2-13, 1995 Data		National Estimates, Ages 0-17 1987 Data[1]	HMO Enrollees Ages 1-17 1992 Data[2] (n=3531)	HMO Enrollees All Ages 1993 Data[3] (n=25,614)
	Alabama (n=1851)	Michigan (n=5909)			
% Pharmacy	38.9	34.9	14.4	21.1	38
% Routine Ambulatory Care	27.1	31.0	20.9	41.2	21.0
% Urgent Ambulatory Care	2.9	0.2	11.9	11.3	8.0
% Inpatient Care	31.1	33.9	53.5	26.3	32.0
Mean $ per Care User per year	$439.23 (Amount paid)	$455.37 (Amount paid)	$821.18 (Reported expenditures 1994 dollars)	$389.57 (HMO cost of providing services)	$467.40 (Amount Paid)

[1] Calculated from expenditure data presented by age in Table 3 of Smith et al, 1997, with mean cost calculated using population size estimates presented in Table 1 of that publication. Population includes those with a medical event coded with ICD9 code 493 in National Medical Expenditure Survey.

[2] Calculated from Table 4 of Lozano et al, 1997. Population includes those with ambulatory medical claim coded with ICD9 code 493.

[3] Figure 1 in Stempel et al 1996b. Population includes those with medical claim coded with ICD9 code 493 or two or more filled prescriptions for asthma medications.

Three issues need to be taken into account when comparing expenditure data across studies. First, as noted above, we have used a strict definition of urgent ambulatory care for this study, including only visits in which children were administered nebulized medication for respiratory distress. The routine care category for our study includes some visits provided in hospital emergency departments where nebulized medication was not provided (that is, not billed to Medicaid). In contrast, the expenditures listed in Table 8 for urgent ambulatory care from the Smith et al national expenditure study and the Stempel et al HMO study include expenditures reported for emergency department care. We grouped the expenditures reported in those studies for office, clinic and hospital outpatient care into the category of routine ambulatory care in Table 8. The expenditures listed in Table 8 for urgent ambulatory care from the Lozano et al HMO study were for all visits occurring outside of regular office hours.

Second, the population base included in these studies is not identical, as indicated in the notes for the table and in the Methods section above. Both the Stempel et al study and the current study, which show proportionately higher expenditures on medications than the other studies, included children who probably have asthma but who did not receive an explicit diagnosis of asthma in a medical encounter in the year. In the Stempel et al study, some included children received asthma medications during the year, although they did not have a medical visit with "asthma" as a diagnosis. In our study, some included children received three or more asthma-like diagnoses in the previous year, and were continuing to use care for similar complaints in the current year.

A third consideration that must be made in interpreting these data is that pricing differences may alter the distribution of expenditures. It may be the case, for example, that Medicaid programs pay more for pharmaceuticals but less for medical care than do most HMO's (particularly considering the well documented discounting of provider fees in Medicaid programs, PPRC 1994). Still, taking these considerations into account, these data do suggest that patterns of expenditures on asthma for children may be shifting over time, with more being spent on pharmaceutical care and less spent on inpatient care.

Variability in the severity of asthma in children and in children's utilization of care mean that many children in our cohort have annual expenditures much lower than the mean amount, while some children have expenditures that are much higher. Table 9 examines utilization patterns for different services and the average expenditures on these services per user.

Table 9 Utilization and Annual Expenditures per User by Service Type

	Alabama		Michigan	
	% with Any Use	Mean (std) Cost Per Child/User	% with Any Use	Mean (std) Cost per Child/User
Pharmaceuticals				
Acute Meds	84.6	$114.23 (172.59)	84.4	$95.57(98.76)
Preventive Meds	42.9	$171.69 (223.94)	44.2	$176.55 (223.22)
Urgent Care				
Inpatient	5.2	$2634.82 (2700.88)	4.9	$3140.76 (3067.62)
ED	5.6	$115.86 (77.39)	2.5	$118.70 (88.27)
Procedure	9.2	$19.02 (24.99)	6.6	$22.27 (24.79)
Exam	12.3	$52.30 (49.22)	6.8	$39.13 (31.02)
Lab	1.7	$14.10 (8.16)	.5	$19.36 (16.19)
X-ray	2.2	$23.77 (9.09)	1.1	$21.16 (8.30)
Total Urgent	16.7	$892.24 (1919.07)	12.8	$1313.44 (2508.26)
Routine Care				
ED	19.1	$95.39 (113.40)	22.9	$138.59 (172.04)
Procedure	14.2	$54.16 (83.13)	26.2	$157.88 (1697.37)
Exam	74.6	$113.29 (129.72)	74.2	$76.99 (118.82)
Lab	14.2	$13.69 (15.27)	9.1	$26.25 (30.53)
X-ray	6.2	$28.15 (16.41)	9.7	$22.70 (16.91)
Total Routine	78.0	$152.50 (191.01)	79.4	$178.08 (1008.83)

Rates of use of pharmaceuticals, inpatient care and routine care for the cohorts of children with asthma who are care users are similar in the two states. Hospitalization rates for this pediatric population are slightly lower than those reported by Lozano et al (1996) for an HMO enrolled population ages 1-17 (hospitalization rate of 6.1%) and similarly lower than those reported for an urban clinic patient population ages 5-34 years (7.8% for African Americans, 6.3% for Whites, Murray, Stang and Tierney 1997). There was somewhat more use of urgent ambulatory care (i.e., visits with administration of nebulized medication) in Alabama than in Michigan, although this may represent simply a treatment preference (or procedure billing) difference in the two states, rather than any real difference in the use of ambulatory care perceived to be urgent. Hospital emergency departments are clearly an important source of routine as well as ambulatory care for children in both states.

EXPENDITURES FOR URGENT CARE USE

Table 8 showed that urgent ambulatory and inpatient care accounted for more than one third of total asthma expenditures in both Alabama and Michigan in 1995, while Table 9 showed that only 16.7% and 12.8% respectively of asthma care users in these two states had these types of expenditures, and only about 5% of children used inpatient care. This illustrates again the commonly observed phenomenon that a small portion of children generate a large portion of expenditures for asthma care. Since inpatient and urgent ambulatory care are thought to be preventable, particularly with good pharmaceutical management, it is useful to examine whether in fact urgent care users are also children with lower expenditures on pharmaceuticals. Table 10 compares mean expenditures for medications, urgent and routine services for children who did and did not use any urgent (inpatient or ambulatory) care in 1995. We stratify these data by severity of asthma, categorized as described above. For ease of comparison, we present the expenditures for children with mild asthma and no urgent care use in dollar form for each state, and present the expenditures for other groups in the form of the ratio to these expenditures.

Table 10 Expenditures For Care by Users and Non-Users of Urgent Care, Indexed to Expenditures for Mild Cases with No Urgent Care Use within States

Urgent Care Use	N (% Total in State)	Mean (std) Cost Preventive Meds[1]	Mean (std) Cost Acute Meds[2]	Mean (std) Cost Urgent Care	Mean (std) Cost Routine Care	Mean (std) Cost Total Care
Mild Asthma – Alabama						
No	962 (52.0%)	$ 10.67 (39.56)	$48.24 (98.92)	$ 0	$78.70 (103.03)	$137.62 (179.54)
Yes	133 (7.2%)	3.5 (2.4)	2.4 (1.5)	624.1 (1007.53)	2.3 (1.8)	6.9 (6.7)
Moderate/Severe Asthma – Alabama						
No	579 (31.3%)	13.1 (5.4)	2.7 (1.8)	0	1.6 (1.6)	2.8 (2.4)
Yes	177 (9.6%)	21.2 (7.0)	4.9 (2.7)	1093.7 (2368.41)	3.6 (3.4)	13.4 (15.5)

Mild Asthma --- Michigan						
No	3203 (54.6%)	$ 15.00 (54.62)	$42.17 (73.35)	$ 0	$98.79 (1143.44)	$155.95 (1150.22)
Yes	133 (7.2%)	3.5 (2.4)	2.4 (1.5)	624.1 (1007.53)	2.3 (1.8)	6.9 (6.7)
Moderate/Severe Asthma --- Michigan						
No	2008 (34.0%)	10.1 (3.9)	2.7 (2.1)	0	1.3 (.4)	2.5 (.5)
Yes	396 (6.7%)	16.2 (5.6)	5.4 (3.6)	1619.7 (2793.46)	4.7 (.5)	16.4 (3.0)

[1] Includes expenditures for cromolyn sodium, theophylline and inhaled corticosteroids.

[2] Includes expenditures for beta agonists and oral corticosteroids

Children with severe asthma who use urgent ambulatory and/or inpatient care clearly have the highest treatment expenditures of all children with asthma. Total costs are twice those of children with mild asthma who also use urgent care, and 13 to 16 times higher than children with mild asthma who do not use urgent care. However, within asthma severity levels, pharmaceutical costs are higher for urgent care users than for non-users of urgent care. Across both asthma severity levels, routine care costs for children using urgent care are higher than for non-users of urgent care. Thus the anticipated substitution of pharmaceutical expenditures and routine care expenditures for urgent care expenditures is not observed within these population groups.

It is possible that even though expenditures on pharmaceuticals are higher in general for urgent care users, children with the most consistent use of asthma pharmaceuticals, particularly preventive regimes, have less use of urgent care than those whose use of pharmaceuticals is less consistent. Stempel et al (1996a) showed that within an HMO population of children with severe asthma (i.e., children with frequent use of acute asthma medication), children with no use of a preventive medication (inhaled corticosteroids) had very low urgent care use. This is similar to the finding reported here. However, children with inadequate doses of the medication had more frequent urgent care use than children with adequate doses. This finding highlights both the individual variability of disease severity and urgent care use, and also the impact of inadequate compliance with medication regimes on other types of care utilization.

Table 11 compares the rates or urgent care use and average pharmaceutical and urgent care expenditures across children whose prescription refill patterns indicate medication availability all year, part of the year or none of the year, as described above. For this comparison, we consider only the availability of beta agonists as acute medications, although expenditures for oral corticosteroids are still included in acute medication costs.

Table 11 Urgent Care Use by Extent of Preventive Medication Use

Prevent-ive Med Use	Beta Agonist Use	N (% of Total in Severity Level)	N (%) Using Urgent Care	Mean (std) Cost Prevent-ive Meds	Mean (std) Cost Acute Meds	Mean (std) Cost Urgent Care for Users
Mild Asthma – Alabama						
None	None	228 (20.8%)	9 (3.9%)	0	$2.96 (17.08)	$607.25 (578.27)
	Part Year	577 (52.7%)	54 (9.3%)	0	$38.61 (67.82)	$380.93 (922.48)
	All Year	104 (9.5%)	20 (19.2%)	0	$157.85 (161.58)	$534.06 (796.70)
Part Year	None	15 (1.3%)	1 (6.6%)	$35.96 (29.00)	$1.57 (4.70)	$1044.23 ---
	Part Year	121 (11.0%)	32 (26.4%)	$65.30 (63.30)	$70.68 (58.04)	$918.59 (1150.24)
	All Year	50 (4.6%)	17 (34.0%)	$134.74 (147.37)	$271.87 (235.53)	$932.12 (1255.54)
Moderate/Severe Asthma – Alabama						
None	None	19 (2.5%)	1 (5.2%)	0	$4.09 (8.24)	$168.40 ----
	Part Year	103 (13.6%)	20 (19.9%)	0	$45.44 (43.19)	$247.31 (723.02)
	All Year	26 (3.4%)	8 (30.7%)	0	$161.93 (111.03)	$252.89 (416.59)
Part Year	None	23 (3.0%)	1 (4.3%)	$44.07 (58.13)	$2.55 (6.66)	$93.62 -------
	Part Year	300 (39.7%)	57 (19.0%)	$95.06 (106.30)	$74.33 (68.41)	$1026.83 (2944.91)
	All Year	224 (29.6%)	66 (29.5%)	$225.64 (170.13)	$271.03 (219.96)	$1140.63 (1691.78)
All Year	Part Year	6 (0.8%)	1 (16.7%)	$624.99 (443.94)	$97.79 (60.51)	$103.76 ---------
	All Year	55 (7.3%)	23 (41.8%)	$675.88 (371.52)	$467.62 (362.06)	$2282.76 (3361.25)

Mild Asthma – Michigan						
None	None	739 (21.1%)	24 (3.2%)	0	$1.51 (6.98)	$793.21 (1692.13)
	Part Year	1838 (52.4%)	129 (3.7%)	0	$31.94 (37.05)	$537.36 (913.65)
	All Year	274 (7.8%)	25 (9.1%)	0	$137.31 (126.01)	$397.92 (808.20)
Part Year	None	48 (1.4%)	5 (10.4%)	$31.67 (43.22)	$4.37 (10.86)	$359.60 (781.73)
	Part Year	445 (12.7%)	81 (18.2%)	$85.87 (99.03)	$71.74 (72.84)	$1123.67 (1355.52)
	All Year	160 (4.6%)	38 (23.7%)	$130.58 (161.23)	$200.65 (161.23)	$2217.16 (4603.45)
All Year	All Year	1 (.02%)	0 (0)	$480.00 (------)	$351.00 (-------)	0
Moderate/Severe Asthma – Michigan						
None	None	68 (2.8%)	10 (14.7%)	0	$1.98 (4.94)	$727.50 (2268.23)
	Part Year	318 (13.2%)	40 (12.6%)	0	$35.61 (38.48)	$456.95 (962.63)
	All Year	63 (2.6%)	14 (22.2%)	0	$157.87 (140.88)	$120.79 (399.44)
Part Year	None	65 (2.7%)	1 (1.5%)	$80.81 (119.43)	$1.55 (4.48)	$9.00 (------)
	Part Year	992 (41.3%)	125 (12.6%)	$94.52 (100.73)	$62.59 (61.64)	$1247.22 (1704.41)
	All Year	678 (28.2%)	159 (23.4%)	$232.62 (194.92)	$225.52 (186.36)	$1982.73 (3276.28)
All Year	None	3 (0.1%)	0 (0)	$790.00 (890.67)	$11.33 (19.63)	0
	Part Year	35 (1.4%)	3 (8.6%)	$449.71 (224.02)	$72.63 (57.24)	$816.67 (1396.32)
	All Year	182 (7.6%)	44 (24.2%)	$685.03 (315.56)	$423.29 (320.14)	$3194.34 (4012.53)

Table 11 shows that the few children who have active medication regimes all year also tend to have the most frequent and the most expensive urgent care use during the year. For these children, pharmaceutical use does not substitute for urgent care use, although of course it is impossible to know how much more frequent or costly their urgent care use would have been without asthma medications.

Table 11 also shows that the Alabama and Michigan Medicaid programs have similar distributions of children with various patterns of use of preventive and beta agonist medications. The NAEP guidelines current during this claims period (NHLBI 1991) indicate that children with mild asthma should have year long availability of beta agonist medication, while children with moderate or severe asthma should have preventive medication as well as beta agonist availability. The children in these two cohorts had all been diagnosed with asthma in 1994, and all used some type of care for asthma or asthma-like symptoms in 1995. Yet only 14% and 12.4% of children with mild asthma in Alabama and Michigan respectively had year long availability of a beta-agonist prescription. For children with moderate to severe asthma, 40.3% and 38.4% in Alabama and Michigan respectively had year long availability of a beta agonist prescription, while 8.1% and 9.1% respectively had year long availability of any preventive medication. Thus, comparing these medication claims data to asthma treatment guidelines, Medicaid covered children in Alabama and Michigan were generally under-medicated for asthma in 1995.

EXPENDITURES REQUIRED TO IMPROVE MEDICATION USE

How much greater would expenditures on asthma medication need to have been in 1995 to bring all of the covered children in compliance with NAEP recommendations? How much of a reduction in other types of care use would have been required to balance such this expenditure? One difficulty with making this estimate is that the per person expenditures for medications are highly variable, as indicated by the large standard deviations for the means, shown in Table 11. Table 12 shows the difference between the amount currently spent on asthma medications for this population, and the amount that would be spent if all children received the recommended treatment regime, estimated using both the current average expenditure and, to correct for variability in the means, the median expenditure on medications for children with year long availability of recommended medications. The last column in the table shows the percent that this amount constitutes of the current total expenditures on care within the severity level, thus indicating the amount of care that would have to be reduced to balance the additional medication expenditures.

Table 12 Estimated Cost of Meeting NAEP Treatment Recommendations for Alabama and Michigan Children Covered by Medicaid in 1995

	Per Person Cost	Current Expenditure All Cases	Expenditure if Standards Met for All Cases	Cost Difference	% of Current Total Care Use for Severity Level
Mild Asthma – Alabama (All Year Availability of Acute Medications)					
Mean Cost	$194.87	$61,598.49	$213,382.65	$151,784.16	58.5%
Median Cost	$137.30	$61,598.49	$150,343.50	$ 88,745.01	34.2%
Moderate/Severe Asthma – Alabama (All Year Availability of Acute and Preventive Medications)					
Mean Cost	$1146.20	$239,487.95	$866,527.20	$627,039.25	113.2%
Median Cost	$972.63	$239,487.95	$735,308.28	$495,820.33	89.5%
Mild Asthma – Michigan (All Year Availability of Acute Medications)					
Mean Cost	$161.10	$161,897.46	$564,655.50	$402,758.04	45.2%
Median Cost	$124.00	$161,897.46	$434,620.00	$272,722.54	30.6%
Moderate/Severe Asthma – Alabama (All Year Availability of Acute and Preventive Medications)					
Mean Cost	$1456.91	$715,622.72	$3,502,411.64	$2,786,788.92	154.6%
Median Cost	$998.50	$715,622.72	$2,400,394.00	$1,684,771.28	93.6%

Table 12 shows that the median costs are lower than the mean costs for complete medication coverage. Some children with complete medication coverage have very high medication expenses, filling more prescriptions than should strictly be necessary for active medication coverage. This could occur if physicians were experimenting with different medications, if children over used some pharmaceuticals or if patients received duplicative prescriptions, perhaps due to misplaced medications or the need to keep medications available in multiple locations. Still, if median costs are used for these estimates, the additional expenditures needed to provide all year medication coverage to children with moderate or severe asthma is nearly equal to the total costs of other types of care. The additional expenditures needed to provide acute medication coverage to children with mild asthma is about one third the total cost of care for the group. Although the per person costs for total medication coverage is lower individually than what is frequently spent on urgent care, urgent care is used by only a small portion of the population. The additional expenditures needed to provide all year medication availability to the whole population are larger than the total spent on urgent care within asthma severity levels. Thus even total elimination of urgent care would not balance the additional expenditures required for total medication coverage. Furthermore, total elimination of urgent care use is unrealistic, given that the most frequent and costly levels of urgent care are used by children who already have full year medication availability.

DISCUSSION

FINDINGS: CLAIMS VALIDATION

AVAILABILITY OF DATA ELEMENTS FROM MEDICAL RECORDS

In our template for medical record abstraction, we identified components of the medical record that could also be used for assessing the urgency of an encounter and the severity of a child's disease. Table 13 displays these items and shows the portion of the matched medical records which had information actually recorded for these items.

Table 13 Availability of Data Elements for Urgency and Severity

Indicators of Visit Urgency	% Documented	Indicators of Disease Severity	% Documented
Presenting Complaint	92.4	Specialty Care Used	1.0
Disposition	96.2	ED Visits in Year	0
Episode Severity	5.5	Intensive Care Episodes in Year	.3
Medication Administered	7.5	Hospitalizations in Year	.3
Procedures	13.4	Taking Oral Steroids	2.8
Pulse Rate	42.9	Prior Asthma Episode	36.7
Reason for Visit	99.7	Prior Coughing	.3
Respiratory Distress	78.2	Prior Respiratory Problems	6.2
Respiration Type	7.7	Prior Reactive Airway Disease	6.6
Respiration Rate	39.4	Referral	56.7

Urgency (abstractor's assessment based on record)	49.5	Activity Limitations	1.0
		School Loss	3.8
		Nocturnal Symptoms	0
		Symptom Frequency	0
		Symptom Pattern	.3
		Disease Severity (abstractor's assessment based on record)	.7

As Table 13 illustrates, indicators of urgency of an encounter are better documented on the medical record than items that would indicate asthma severity. Even so, overall urgency of the encounter could only be assessed by the record abstractors in about half of the encounters. Comparing this subset of records with urgency imputed from claims, we found that of the encounters considered "urgent" by record abstractors 55.2% were also flagged as "urgent" using our claims algorithm. We also found that all of the encounters flagged as "urgent" using claims were also considered "urgent" in the record abstraction. Of the three records for which severity was assessed by the abstractor, all agreed with the severity assessed on the basis of claims data.

CORRESPONDENCE OF DATA ELEMENTS

The claims data collected for the sample of children with asthma include information on the place of service and the specialty of the provider. The procedure code on the claim is used to indicate whether a procedure such as nebulizer treatment was provided during the visit. For the most part, reimbursement for services is based on the procedure recorded on the claim, and procedures are generally thought to be among the most accurately coded elements of claims data (Fowles et al 1995). Table 14 shows the portion of matched claims and records which included parallel information in the medical record that could be compared to the information on the Medicaid claim.

Table 14: Correspondence of Data Elements

Data Item Recorded in Claim	Unable to Determine from Record	Recorded Differently in Record and Claim	Identical in Both Claims and Record
Place of Service	65 (14%)	44 (9%)	351 (76%)
Specialty of Provider	343 (74%)	18 (4%)	99 (21%)
Claim for Nebulizer during encounter	Nebulizer Treatment Recorded in Record	Nebulizer Treatment not Recorded in Record	Unable to Determine if Nebulizer Treatment Provided
Yes	16 (89%)	0 (0%)	2 (11%)
No	13 (3%)	191 (43%)	238 (54%)

Table 14 shows that, where data elements are available on both medical records and claims, correspondence between the two data sources is relatively high. However, it is important to note that Medicaid claims identified only 55% (16 of 29) encounters in which nebulized medication was (apparently) provided. This corresponds to the finding above, which also suggested that claims failed to identify about half of the encounters which appear to be urgent, based on medical records data.

Because accurate diagnosis of asthma is a concern when assessing the quality of care provided for this disease, we were especially interested in examining whether the diagnosis coded on the Medicaid claims corresponded to the diagnosis recorded in the medical record. To the extent that claims and records diagnoses correspond, claims can be used to assess whether clinicians are accurately diagnosing asthma, or whether they are diagnosing general respiratory syndromes or other conditions. If claims and records diagnoses disagree, however, claims would need to be considered less than reliable for identifying problems with disease diagnosis. In general terms, while administrative data are thought to be relatively accurate in recording procedures, they are thought to be mediocre sources of information on diagnoses. This is particularly true if very specific information on diagnosis is required, or if the diagnosis in question is a co-morbidity or chronic problem which may not be the specific focus of the medical encounter (Steinberg et al 1990, Fowles et al 1995).

For this data validation study, we divided claims and records diagnoses into three categories. The two data sources were considered to have recorded "asthma" as the diagnosis if the terms "asthma" or "reactive airways disease" were recorded on the record, or if the ICD9 code "493" or any sub-code were recorded on the claim. There is no ICD9 code for "reactive airways disease". Claims or records were considered to have recorded an "asthma-like" diagnosis if any of the additional terms or codes described in the Methodology section above, or the term "broncho-spasm" were used. If the diagnosis on the claim or the record did not fit either of these categories, they were considered to have recorded a diagnosis of "Other". Table 15 shows the distribution of these categories of diagnoses in the matched records and claims.

Table 15 Correspondence of Diagnoses

Diagnoses Recorded on Claim	Diagnoses Recorded on Medical Record			Total
	Asthma	Asthma-like, not Asthma	Other	
Asthma	83	2	9	94
Asthma-like, not Asthma	14	24	10	48
Other	39	16	254	309
Total	136	42	273	451

Overall, 80% of the diagnoses recorded on the claims (361 of 451) fell into the same categories as the diagnoses recorded on the medical records. We found that 88% (83 of 94) of Medicaid claims recording asthma were based on medical records that also recorded asthma as the diagnosis. These represented 61% (83 of 136) cases in which asthma was recorded on the medical record. Thus, as with the measures of urgency and the administration of nebulized medication, the diagnosis on the claim had better specificity than sensitivity. The children identified as having asthma with claims data for the most part had asthma based on records data, but they are not the complete group of children whom physicians described as having asthma in the encounter of interest.

Overall 50% (24 of 48) of the claims recording an "asthma-like" diagnosis were for records with an "asthma-like" diagnosis. An additional 29% (14 of 48) of the claims with an "asthma-like" diagnosis on the claim were for records in which the clinician had recorded that the patient had asthma. This finding validates the use of "asthma-like" diagnoses on claims to identify children being treated for asthma. However, it raises concern about designating the use of an asthma-like diagnosis on the claim rather than an asthma diagnoses as a treatment problem. In one-third of the cases, this is a bill coding error rather than a diagnostic error. The finding that 29% (39 of 136) records recording asthma have an "other" (non-respiratory) diagnosis on the claim may well represent the phenomenon of recording the presenting problem on a claim without recording a co-morbidity or an underlying chronic condition. It is important to note that these children had already been identified as having asthma, based on their entire claims history.

CORRESPONDENCE OF DATA ON ASTHMA MEDICATIONS

Our research project has used claims filed for asthma medications as an indicator of whether asthma medications are available to patients, whether the appropriate form of asthma medication has been prescribed, and whether contra-indicated treatments, in this case narcotic cough medicines, were available. The claims for these medications are filed by the pharmacies where prescriptions are filled, and the claims include the license number of the physician who wrote the prescription. Filed claims thus indicate filled prescriptions and are a fairly good indicator of the medications available to a patient, although they do not measure whether medications are used appropriately. Whether or not claims are a good indicator of the prescribing patterns of physicians depends on whether all written prescriptions are filled, and on whether physicians provide any medications directly, without also writing a prescription.

For this validation study we have focused on whether medications noted as having been prescribed to a patient during an encounter correspond to claims filed for asthma medications at some time after the encounter. We focused on three medications used in the treatment of children with asthma: preventive asthma medications as identified in the Methodology section, above, beta agonists and narcotic cough medications. We compared claims and record correspondence rates for these medications to claims and records correspondence for antibiotics in order to examine whether asthma medications have any unusual patterns. We used the NDIC codes recorded on the medication claims to sort the claims into the four categories. We used the text of the medication recorded on the medical record to sort those prescriptions into the same four categories. As noted above, our study also uses claims data to assess whether the oral or inhaled form of a beta agonist was dispensed to the patient. We were unable to make this comparison with the medical records data, as the form of a medication was generally not recorded in the record.

Table 16 examines the total number of medications documented as having been prescribed at the medical encounters abstracted from the medical records, and shows how many claims were filed for these medications up to one year after the date of the medical encounter. Note that medication claims that did not correspond to the medications noted on the patient record were not considered matches for the record data.

Table 16 Newly Prescribed Medications Filled

Documented in Medical Record	Claims Filed				
	Total	Filled on Same Day	Filled 1- 7 Days Later	Filled 8-365 Days Later	Not Filled
Preventive Med	33	13 (39.4%)	7 (21.2%)	3 (9.1%)	10 (30.3%)
Beta Agonist	84	35 (41.7%)	13 (15.5%)	10 (11.9%)	26 (30.9%)
Narcotic Cough Med	58	40 (69.0%)	1 (1.7%)	4 (6.9%)	13 (22.4%)
Antibiotic	218	153 (70.2%)	32 (14.7%)	15 (6.9%)	18 (8.3%)

Table 16 shows that nearly one third of the prescriptions written for acute and preventive asthma treatment remain unfilled for substantial lengths of time. The portion of unfilled prescriptions for narcotic cough medicines is less, and the portion of unfilled prescriptions for antibiotics is much less than those rates for asthma treatments. Narcotic cough medicine and antibiotic prescriptions are also filled more promptly than prescriptions for asthma medication. To the extent that prescriptions remain unfilled, claims data are not the best indicators of clinician prescribing patterns. However, claims data are very helpful in indicating the extent of the gap between what physicians provide in terms of asthma treatment and what patients actually receive.

Would medical records themselves be a better source of information on treatments provided by physicians? To assess this question, we examined whether prescriptions which were filled (had claims filed with Medicaid for reimbursement) had been documented in medical records. Pharmacy claims are filed separately from medical claims, and the license number of the prescribing physician on the pharmacy claim does not always match the license number of physicians billing for medical care of the patient. Thus we assessed this question only for cases where all of the known medical records for the year had been abstracted. For this subset of 32 patients, we identified claims filed for the four categories of medications between January and March of 1995. We then searched the medical records of these individuals for the previous twelve months, and identified if and when prescriptions for these medications had been documented. These findings are shown in Table 17.

Table 17 Records Documentation of Filed Claims

Claim Filed Jan-March 1995		Prescription Documented in Medical Record			
	Total	Prescribed Same Day	Prescribed 1-7 Days Before	Prescribed 8-365 Days Before	Not in Medical Record
Preventive Medication	3	1 (33.3%)	1 (33.3%)	-------------	1 (33.3%)
Beta Agonist	16	8 (50.0%)	------------	2 (12.5%)	6 (37.5%)

Narcotic Cough Med	9	8 (88.9%)	------------	-------------	1 (11.1%)
Antibiotic	32	18 (56.2%)	7 (21.9%)	-------------	7 (21.9%)

Table 17 shows that about one third of the pharmaceutical claims for asthma treatment filed by this subset of patients were not documented as having been prescribed in the medical record. Documentation was better for antibiotics and narcotic cough medicines, although, comparing Tables 16 and 17, more antibiotic prescriptions are filled and not documented in the medical record, than documented but not filled, based on claims data. Like claims data alone, the use of medical records alone to assess physicians' prescribing patterns underestimates the extent of medications actually prescribed for the treatment of asthma.

DISCUSSION

FINDINGS: SIMULATION OF REMINDER SYSTEM

DISTRIBUTION OF PROBLEMS ACROSS PATIENTS AND PHYSICIANS

Table 18 examines the demographics of children from the 1994 cohort whose treatment in January of 1995 would have triggered a reminder letter to a physician in our simulation model. These children are compared in terms of demographics to all children seen in January 1995.

Table 18 Demographic Characteristics of Children with Asthma Treatment Problems in January 1995.

Treatment Problems	N (%)	% All Other	% Female	% Rural
Size of Cohort – Alabama	2554			
All Children Seen in January	371 (14.5%)	53.1	58.5	45.6
Missing Follow Up Visit	80 (8.1%)	83.3**	63.3	33.3
Missing Asthma Dx	145 (39.1%)	40.7**	55.2	51.0
Missing Medications	162 (43.7%)	53.1	57.4	48.2
Unduplicated Count of Children	239 (64.4%)	51.5	57.3	48.1
Size of Cohort – Michigan	8634			
All Children Seen in January	1228 (14.2%)	45.5	41.8	19.8
Missing Follow Up Visit	29 (2.4%)	51.7	41.8	17.2
Missing Asthma Dx	454 (37.0%)	41.2 *	51.7	17.0
Missing Medications	476 (38.8%)	42.2	48.0**	22.3
Unduplicated Count of Children	684 (55.7%)	41.5**	44.9*	19.6

Table 18 shows that in both Alabama and Michigan, more than half of the children receiving care for asthma in the month of January experienced one or more of the asthma treatment problems. The most common problem was the absence of active prescriptions for appropriate asthma medications despite having a medical encounter for asthma during the month. The second most common problem was the physicians' failure to use the diagnostic code for "asthma" as opposed to ones for asthma-like symptoms or conditions on claims submitted for the medical encounter. Above we showed that these events tend to be related, with children whose last asthma medical encounter did not include an explicit asthma diagnosis being significantly less likely to have appropriate asthma medications available. Failure to have a follow up visit after an urgent care visit was generally less common, but only because the rate of urgent visits and hospitalizations is relatively low.

Table 18 also shows again that in both states, black and other children were less likely to have missed a diagnosis of asthma than white children. As we discussed above, in both Michigan and Alabama, there is actually a slightly lower prevalence but a higher severity level of asthma among black and other children. This suggests that black and other children may be generally more likely to receive diagnoses of asthma because those seeking any medical care for their symptoms (and thus, those represented in our asthma cohorts) have more persistent and severe asthma symptoms than white children. Finally, Table 18 also shows that, in Alabama, black and other children disproportionately fail to receive follow up visits after urgent care or inpatient encounters.

Table 19 shows the distribution of problem indicators across physicians providing asthma related care to children in the two state cohorts in January 1995.

Table 19 Distribution of Asthma Treatment Problems Across Physicians

	Alabama		Michigan	
	N (%)	N (%)>1 Patient	N (%)	N (%) > 1 Patient
All MDs seeing Children in January	243 (100%)		902 (100%)	
Missing Follow Up Visit	28 (11.5%)	5 (17.9%)	37 (4.1%)	5 (13.5%)
Missing Asthma Dx	128 (52.7%)	30 (23.4%)	317 (35.1%)	58 (18.3%)
Missing Medications	113 (46.5%)	26 (23.0%)	298 (33.0%)	73 (24.5%)
Unduplicated Count of Contact MDs	181 (74.5%)	46 (25.4%)	449 (49.8%)	109 (24.3%)

Table 19 shows that the treatment problems we have identified occurred across a sizeable proportion (75% in Alabama and 50% in Michigan) of physicians providing care in the month. However, less than one quarter of the physicians in each state are associated with the same treatment problem for more than one child, while only 33% (in Alabama) and 20% (in Michigan) are associated with more than one treatment problem in the month. Failure to diagnose a problem specifically as asthma and failure to assure that a child has active medications are the two most common problems.

POTENTIAL IMPACT OF REMINDER LETTERS

Table 20 examines the potential impact of a letter reminder concerning the three asthma treatment problems. The simulation is designed so that the impact varies based on whether the child had an on-going relationship with the physician, whether the child saw the physician again between March and December of 1995, and whether the physician would change care only for the child mentioned in the letter or for all children seen for asthma between March and December of the year. We show the impact both on all of the children seen with asthma and on the subset of children who also had one or more of the three asthma care problems between March and December 1995.

Table 20: Potential Impact of Changed Physician Behavior on the Care of Children with Asthma

Alabama	Assumptions of Letter Effectiveness			
Potential Impact	1. All receivers respond by changing care for all children with problem asthma care whom they see in 1995	2. Those receiving letters on regular patients respond by changing care for all children with problem asthma care whom they see in 1995	3. All receivers respond by changing care only for the letter subjects whom they see later in 1995	4. Those receiving letters on regular patients respond by changing care only for the letter subjects whom they see later in 1995
Number of MDs Changing Practice (%of those seeing patients in January	181 (74.5%)	128 (52.6%)	101 (41.5%)	91 (37.4%)
Number of letters with an impact on physician behavior	239	188	141	131

Number of children with asthma affected (% of all seen in 1995)	756 (29.6%)	577 (22.6%)	141 (5.5%)	131 (5.1%)
Number of children with problem asthma care affected (% of all with poor care in 1995)	498 (48.3%)	452 (43.9%)	86 (8.3%)	80 (7.8%)
Michigan				
Number of MDs Changing Practice	449 (49.8%)	317 (35.1%)	252 (27.9%)	228 (25.2%)
Number of letters with an impact on physician behavior	684	559	452	428
Number of children with asthma affected (% of all seen in 1995)	2296 (26.6%)	1791 (20.7%)	452 (5.2%)	425 (4.9%)
Number of children with problem asthma care effected (% of all with poor care in 1995)	1461 (48.1%)	1304 (42.9%)	263 (8.7%)	255 (8.4%)

Table 20 shows that, contrary to our expectations concerning fragmented care systems, 70.7% (128/181 in Alabama) and 70.6% (317/449 in Michigan) of physicians who would receive reminder letters concerning care provided in January 1995 had seen the subject children at least once before in the preceding twelve months. Furthermore, 53.4% (101/189 in Alabama) and 56.1% (252/449 in Michigan) of physicians see the subject children again in 1995, and 71.1% (91/128) and 71.9% (228/252) see their regular patients again in 1995. Data in the table also indicate that repeated incidents of problem care are common. Of all of the children seen during the year by physicians receiving letters in January, 65.8% (498/756 in Alabama) and 63.6% (1461/2296 in Michigan) have problem care events at some point in the year. The rate of problem care is even higher for established patients of these physicians, including 78.3% (452/577 in Alabama) and 72.8% (1304/1791 in Michigan). The rate of repeat events is slightly lower for letter subject children who had one or more indicators of problem care in January, but 61% (86/141 in Alabama) and 51.5% (263/452 in Michigan) had continued care problems during the year.

Because the physicians receiving reminder letters in January constituted such a large portion of the physicians providing asthma care to cohort children that month, and because children with problem asthma care constituted such a large portion of all children seen by these physicians, there is a great potential for letters sent in just one month to affect a large portion of children. In both states, one month of reminder letters could potentially affect one half of all of the children with problem care indicators during the year. The effect is much more modest if we assume that physicians would alter practices only for children named in the letter. In that case, 8% of all children with problem asthma care would be affected by the mailing. The impacts are almost identical in both Alabama and Michigan, even though the physicians receiving letters in Michigan would have been a somewhat smaller portion of all physicians providing asthma care in the month.

CONCLUSIONS

EXTENT OF MEDICATION PROBLEMS IN ASTHMA TREATMENT

Medication costs accounted for nearly one third of expenditures on asthma for children ages 2-13 covered by Medicaid in Michigan and Alabama in 1995. Medications for the treatment of acute symptoms of asthma, including beta agonists and oral corticosteroids, were used (that is, prescriptions were filled) by about 85% of the children with asthma in each state (Table 9). Medications for the prevention of asthma exacerbations, including theophylline, inhaled corticosteroids and cromolyn sodium, were used by about 43% of children in both states (Table 9), including 81% of those with moderate or severe asthma (Table 11) (with severity classified based on past use of urgent asthma care or preventive medications). However, tracking the refill patterns for these prescriptions over time revealed that few children (about 14% of those with mild asthma and 7% of those with severe asthma) maintain active prescriptions for appropriate medications over the course of the whole year.

One reason for these gaps in medication availability for children with asthma may be failure to fill prescriptions for these medications when they were written. We found that about one third of beta agonist and preventive medications documented in medical records did not have a corresponding Medicaid claim indicating that the prescription had been filled. Failure to fill asthma medication prescriptions occurred more frequently than failure to fill prescriptions for narcotic cough medications or antibiotics. Interestingly, this rate of failure to fill written prescriptions for asthma was nearly identical to that recently observed in a community study of children with asthma in New Zealand (Watts et al 1997).

Another reason for gaps in medication availability is probably lack of continual follow-up through routine medical visits. In both Alabama and Michigan, about 40% of children seen for asthma in 1994 have no medical encounters for this condition in 1995 (Table 9).

A third reason may be that some physicians do not write prescriptions for appropriate medications during asthma encounters. Although this is difficult to determine from administrative data, we did find that that children whose most recent medical encounter for asthma took place in a hospital outpatient setting, rather than an office setting, were less likely to have filled prescriptions for asthma medications. We found further that children with high physician continuity were less likely to fill prescriptions (Table 7).

We tested the hypothesis that children with asthma whose pattern of medication refills indicated gaps in availability of acute and preventive medications would have more urgent care (ambulatory and inpatient) use than children with medication availability all year. Such a hypothesis is logical, since well documented clinical studies indicate that regular use of appropriate asthma medications reduces the incidence of asthma exacerbations (NHLBI 1991). However, the hypothesis could not be supported on a population basis with administrative data. Urgent care was used by 13% (Michigan) to 17% (Alabama) of the population during 1995, and was more commonly used by children with greater expenditures and more complete coverage of medications than by other children with asthma (Tables 10 and 11). It is not uncommon that findings on the effectiveness of asthma medication that hold for individuals do not directly translate into findings on effectiveness estimated for populations with very mixed representation of disease states (Sullivan et al, 1996). Many children in this population have mild asthma, and might be unlikely to seek medical care for an urgent exacerbation, even though they are not actively using asthma medications. Active medication use might well improve their activity level and functional status, even if it would not lower health services costs by preventing the use of urgent medical care.

Using the median expenditure on medications for children who do have active prescriptions for appropriate medications all year, we calculated the additional expenditures that would be required if all children with asthma covered by Medicaid in the two states in 1995 received the recommended medication for their asthma severity status. The total amounts for children with mild asthma were $150,000 in Alabama, an increase of 34% in the total currently spent on asthma care for this group, and $435,000 in Michigan, and increase of 31% in the total currently spent on asthma care for this group. The total amounts for children with moderate to severe asthma were $735,000 in Alabama, an increase of 90% in the total currently spent, and $2.4 million in Michigan, an increase of 94% over current expenditures (Table 12). These additional expenditures could not be recouped by decreases in urgent care use for these children, since they are larger than the current amounts spent on such care. We conclude that efforts to provide care for children with asthma covered by Medicaid that meet the current recommendations for asthma treatment will require the investment of additional funds and cannot be expected to generate large dollar savings.

USE OF HEALTH CARE BY CHILDREN WITH ASTHMA

Our study identified children whose Medicaid claims indicated that they had asthma in 1994, and followed care and medication use for these children in 1995. We found that 27% (Alabama) to 31% (Michigan) of children identified in 1994 had no use of care and filled no prescriptions for asthma in 1995, although they remained enrolled in the Medicaid program. An additional 15% (Alabama) and 12% (Michigan) children filled prescriptions but had no medical encounters for asthma during the year. Use of care for urgent episodes of asthma was relatively low. There was a 5% hospitalization rate for asthma in this cohort, and overall 13% - 17% used either inpatient or ambulatory urgent care (Table 9). This may be an underestimate of urgent ambulatory care use. Our comparison of medical records and claims in Alabama indicated that claims for nebulizing medication, our indicator that an ambulatory visit was for urgent care, were filed only 55% of the times that the procedure was documented in the medical record (Table 14). Nearly 80% of the cohort who used any care or medication had a claim for a routine ambulatory visit, and about 20% of care users in each state used hospital emergency departments for this type of care (Table 9).

Despite this substantial use of hospital facilities for ambulatory care, there was a fair amount of continuity of care across physicians. In both states, about 60% of care users saw the same physician in all asthma encounters in 1995 (Table 6). Of the physicians seeing asthma patients in January of 1995 who were associated with one or more indicators of problematic asthma care, 70% were treating children they had seen before, and 55% saw the same children again in 1995 (Table 20). Clearly there are children who use multiple sources of care and are not repeatedly seen in the same care system for their asthma problems, but this is not the case for the majority of children with asthma in these Medicaid cohorts.

We conducted multivariate analysis to assess whether features of children's care utilization were associated with asthma medication availability on any given day in 1995 (Table 7). Several characteristics of children and aspects of their care use were predictive of gaps in medication availability. Children were less likely to have gaps in medication availability if they had more severe asthma, if they were frequent users of asthma ambulatory care, and if their most recent asthma visit was specifically coded with the diagnosis of asthma on the claim. Children eligible for Medicaid because they received Supplemental Social Security for some other form of disability were also less likely to have gaps in asthma medication availability.

Controlling for these factors, children whose last visit for asthma care occurred in a hospital outpatient setting, as well as children with no contact at all with a medical provider were more likely to have gaps in asthma medication availability. Those whose last ambulatory encounter was urgent were less likely to be missing a beta agonist medication, but much more likely to be missing a preventive asthma medication than children whose last encounter was a routine visit. However, those whose last encounter was for inpatient care were more likely to be missing a beta agonist prescription, and inpatient care was not associated with the availability of preventive medications. These findings all reinforce the standard assumption of asthma care, which is that care provided in urgent-oriented settings is not conducive to on-going, appropriate, prevention-oriented treatment of the condition (Fitzgerald et al 1993).

Again, controlling for all of these factors, children who saw the same physician throughout 1995 were more likely to have gaps in medication availability than those who saw more physicians. This may represent the absence of a referral to a specialist for these children, but it also suggests that some physicians may not be familiar with current standard treatments for asthma. In Alabama, some physicians wrote prescriptions for narcotic cough medications for children with asthma. While this occurred less frequently for children who saw the same physician during the year, it occurred more frequently for white children living in rural areas who saw office based physicians and sought care relatively often for asthma-like symptoms.

Use of hospital based care, urgent care and no care at all were more common for black and other and urban children than for white and rural children in both states. Controlling for these factors, and also for asthma severity and diagnostic accuracy, we found that black and other children and those living in urban areas were actually less likely than other children to have gaps in medication availability. They were also less likely to fill prescriptions for narcotic cough medications. This suggests that the treatment deficiencies seen for these children (e.g., Lozano et al 1995) are more a function of the care systems they use than specifically a function of their demographic characteristics. At the same time, there were some indications that the black and other children in our cohorts, who were those seeking care for asthma in 1994, had more severe manifestations of the condition than white children. Prevalence rates among Medicaid eligibles were lower for this group, average severity rates were higher and fewer of them returned for care in 1995. This suggests that there may be more black and other children than white children covered by Medicaid who have symptoms of relatively mild asthma, but who do not receive the benefits of asthma medications and routine care.

USE OF MEDICAID CLAIMS TO MEASURE THE CONTENT OF ASTHMA CARE

Our findings on the comparability of claims and medical records was dependent on the sample of medical records which we were able to acquire based on the voluntary participation of community physicians.

Had we acquired more of the records from encounters with specialists, and more records from physicians who had (apparently) prescribed medications for patients without filing claims for medical encounters, we may have found relatively better or worse records documentation practices, bill coding practices or rates of filling prescribed prescriptions. Such better rates of record acquisition would be achievable if the population in question was being cared for within a managed care organization with a single medical record keeping system, or if record acquisition were conducted under an administrative mandate by an insurer such as Medicaid. However, our study indicates that large numbers of providers must be involved when complete sets of medical records are required for a patient population. Complete sets of records are very important when examining quality of care for chronic conditions (Scholle et al 1996). It is thus likely that any study of the overall quality of health care received by individuals in a population that uses medical records as a source must be conducted on a sample of a population, rather than on the whole population whose care is of interest. Intensive effort is required to achieve a complete set of medical records (Kosecoff et al 1987)

We found weaknesses in both claims and medical records as data sources. Medical records have the potential to provide the level of clinical detail that enables researchers to make the type of judgements on urgency and severity of disease during an asthma encounter which are necessary for assessing the adequacy of asthma treatment. However much of the data that would be needed for this assessment was not actually documented in the medical records we reviewed. A much smaller set of data elements are available in claims data for use in measuring asthma urgency and severity, and these are actually measures of service utilization, rather than measures of health status (Vollmer, Osborne and Buist 1993). While these claims data elements identify urgent asthma encounters accurately, they apparently do not identify all of the urgent asthma encounters that actually occurred for this population. They appeared to identify asthma severity accurately, but would identify only those children with severe asthma who actually used specific services. Thus claims data present an accurate picture of the content of care, within the small set of elements that are recorded, but do not always identify the extent to which a type of care occurs in the population.

In terms of the accuracy of diagnoses on claims data, we found, as the literature suggests (Fowles et al 1995), that children in this population with claims for asthma generally do have asthma, according to their medical records. Accuracy of case finding is enhanced when the broader diagnostic category of asthma-like respiratory diagnoses is used, and when claims for an entire period of time, rather than just a single encounter, are considered. Stated in general terms, claims data again tend to accurately identify clinical cases, but may underestimate the extent to which cases are present in the population.

Can claims data be used to accurately assess whether medication is available to a population? As noted, our findings on the rate at which patients do not fill asthma medications prescribed by physicians are actually identical to those reported in a recent community physician and pharmacy based study of asthma patients (Watts et al 1997). Both show about 60% of prescriptions filled within one week and 30% never filled, and both show that about 37% of filled prescriptions are undocumented in medical records. Thus in a sense, claims data can be a better measure of medication availability than medical records. However, it is a mistake to conclude that the absence of a claim for an appropriate asthma medication indicates a prescribing failure on the part of the physician. Claims data will not reveal whether the medication was prescribed, and it is clear that many prescriptions for asthma medications (as well as other medications, see Steiner and Prochazka 1997, Saunders 1987) are not filled by patients.

Similarly, our study found consistently that children whose encounters were coded with asthma-like symptoms instead of asthma were less likely to have active asthma medication prescriptions. We found that these "missed diagnoses" were more common for white than for black children. Yet, we found that in 30% of the matched claims and records sample, when an asthma-like diagnosis was recorded on the claim, the diagnosis of asthma was recorded in the record. Thus while failure to accurately diagnose and therefore treat asthma is a known phenomenon (Schwartz et al 1990, Gold et al 1993, Cunningham, Dockery and Speizer 1996, Crain et al 1994) which is occurring here, such missed diagnoses cannot be distinguished from simple coding errors using administrative data alone.

We conclude that claims-based content of care indicators are useful for identifying a range of quality problems, including absence of appropriate medications, failure to accurately diagnose the condition and failure to provide follow-up care after urgent episodes. Claims based data do not identify every case of these problems that occurs. It is not possible to ascertain from claims data whether the quality problem is do to provider actions, documentation problems or to the actions of asthma patients and their families.

THE POTENTIAL EFFECTIVENESS OF CLAIMS-TRIGGERED REMINDER LETTERS FOR IMPROVING ASTHMA QUALITY OF CARE

We used claims data to identify three indicators of problematic asthma care: absence of a follow-up visit after an urgent care episode, use of an asthma-like diagnosis on a claim rather than an asthma diagnosis, and continued gaps in medication availability (e.g., no filling of appropriate asthma medication prescriptions) within two weeks of an encounter. It is important to note that all three of these circumstances could occur despite physicians following best practices in terms of the treatment of asthma. Thus the content of any letter to physicians generated from claims data would need to be informative to physicians concerning the status of patients under their care, rather than accusatory of physician failures in treatment.

That said, it is clear that problem care, as defined here and identified using administrative data, is quite common for children with asthma covered by Medicaid, affecting over one half of all children seen in one month. The physicians providing problem care to these children include over half of the physicians providing care in the month. Over 70% of the physicians associated with problem care were treating patients they had seen before, and over 70% of these physicians see these same patients again. Of all the children, new and established patients, who are seen by these physicians in one month, over half are seen again during the course of the year. Thus, it is not the case that problem asthma care is an isolated phenomenon, for either patients or physicians, and it is not the case that most children with problem asthma care lose touch with their physicians over time.

Under these circumstances, a letter reminder system could have a relatively large affect on the care of children with asthma, providing the message was clear and recommended actions which physicians could realistically accomplish. Claims data could be used to provide physicians with a history of the times that children had been seen for asthma-like symptoms in the past, thus supplementing patient histories which may or may not have been taken by physicians, and may not be accurate. Claims data could also inform physicians about whether families filled prescriptions that were written after the child received care. Such information could be used by physicians as a reference, if and when a child returned for care, but preferably the information would be used to reach out to families and encourage them to be seen for routine, prevention oriented asthma care. The extent to which this outreach occurs could also be tracked by claims data. Such an approach is increasingly feasible as Medicaid programs move towards models of primary care case management or other forms of managed care, where administrative structures are in place to identify physicians with on-going health care responsibility for patients.

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APPENDIX A. CRITERIA FOR POPULATION SELECTION

We used earlier years of Alabama Medicaid claims data to test our case finding criteria. Our initial screen for selecting children born between 1977 and 1988 with asthma for study identified all of those children with a Medicaid physician or hospital claim with a diagnosis of asthma (ICD9CM 493 and all extensions) or a diagnosis of an asthma-like respiratory symptom or ailment, including wheezing symptoms (ICD9CM 786.2, 786.09), bronchitis, chronic bronchitis, acute bronchitis and bronchiolitis (490, 491, 466, 466.0, 466.1) and chronic airway obstruction (490) incurred in two "year one's", 1990 and 1991. We also selected children with a paid drug claim of any common asthma medication, including beta-agonists, theophylline and chromolyn sodium. We eliminated from this initial pool any child with a claim for treatment of one of the following chronic respiratory diseases: cystic fibrosis (277.0), other emphysema (492.8), interstitial emphysema (518.1), obstructive chronic bronchitis, with and without acute exacerbations (491.20, 491.21), other diseases of the lung (518.89), diseases of the trachea (519.1), anomalies of the larynx, trachea and bronchus (748.3) and congenital cystic lung (498.4). We also eliminated from the pool any children who were not enrolled in Medicaid for all 12 months of the year one and year two pairs for the sample. Table A.1 shows the initial and net sizes of the pools following this selection process.

Table A.1 Initial and Net Size of Pool for Selection of Study Population

	1990-1991		1991-1992	
	N	%	N	%
Initial Number of Children Identified in Year One	11656	100	15630	100
Number excluded with Chronic Condition	1423	12.2	1607	10.3
Number excluded because not continuously enrolled in Year One	3499	30.0	3776	24.1
Number also excluded because not continuously enrolled in Year Two	566	4.8	1446	9.2
Net Size of Pool for Population Selection	6168	52.9	8801	56.3

As a second step in population selection, we grouped the children remaining in the selection pool according to their category of selection criteria in Year One, as follows: Group One are children with any claim containing a diagnosis of asthma, Group Two are children with no diagnosis of asthma, but with at least three claims incurred on different days with an asthma-like respiratory diagnoses as described above, Group Three are children with one or two claims incurred on different days with one of these asthma-like respiratory diagnoses, and Group Four are children with no claims bearing asthma-like respiratory diagnoses but with one or more claims for asthma medications. We grouped these same children according to the nature of their claims incurred in Year Two, adding a Group Five for children with no asthma, respiratory or asthma drug claims in Year Two.

Tables A.2 and A.3 show the cross-tab of Year One and Year Two categorizations for the whole population in each pair of years. Tables A.4 and A.5 show the percent of children in each selection criteria category in Year One who had signs of continued respiratory problems (asthma diagnoses, other asthma-like diagnoses and/or use of asthma drugs) in Year Two, by age for each pair of years. This percentage can be thought of as the screening yield for each of the Year One criteria, and the corresponding percentage of children with no problems in Year Two can be thought of as the portion whose problems have apparently resolved. The discussion that follows Table A.5 presents our choice of screening criteria to use for this study.

Table A.2 Correspondence of Year One and Year Two Problem Categories: 1990-1991 (Portion in Year One falling into each category in Year Two, Percents, (N))

	N	Asthma Year 2	3 or More Like Dx, Year 2	1-2 Like Dx, Year 2	Only Asthma Drugs, Year 2	No Problems Year 2
Asthma Year 1	1228	41% (503)	2% (25)	14% (170)	14% (167)	30% (363)
3 or More Asthma-like Dx, Year 1	360	11% (38)	19% (67)	37% (133)	7% (24)	27% (98)

1-2 Like Dx, Year 1	3383	4% (145)	3% (108)	26% (879)	7% (229)	60% (2022)
Only Asthma Drugs, Year 1	1197	10% (120)	1% (17)	18% (211)	22% (263)	49% (586)

Table A.3 Correspondence of Year One and Year Two Problem Categories: 1991-1992 (Portion in Year One falling into each category in Year Two, Percents, (N))

	N	Asthma Year 2	3 or More Like Dx, Year 2	1-2 Like Dx, Year 2	Only Asthma Drugs, Year 2	No Problems, Year 2
Asthma Year 1	1535	45% (695)	2% (35)	11% (171)	12% (189)	29% (445)
3 or More Asthma-Like Dx, Year 1	465	10% (49)	13% (62)	34% (159)	8% (37)	34% (158)
1-2 Like Dx, Year 1	5115	5% (258)	3% (132)	20% (1045)	6% (322)	66% (3358)
Only Asthma Drugs, Year 1	1686	11% (180)	1% (22)	14% (236)	24% (399)	50% (849)

Table A.4 Yield of Screening Criteria for Cases in Year Two, by Child's Age, 1990-91

	Percent of Children who Were "Cases" (any asthma-like problems or drugs) in Year Two												
Age	2	3	4	5	6	7	8	9	10	11	12	13	14
Asthma Dx in Year 1	63%	69%	68%	73%	71%	75%	81%	78%	71%	64%	71%	69%	——
Asthma or 3 Asthma-like Dx in Year 1	66%	70%	68%	76%	72%	74%	80%	75%	72%	68%	69%	66%	——
Asthma or Any Like Dx in Year 1	50%	51%	50%	53%	48%	50%	53%	51%	44%	48%	51%	48%	——
Asthma, 3 Like Dx or Asthma Drugs in Year 1	57%	59%	62%	62%	64%	68%	70%	71%	61%	61%	65%	62%	——
Asthma, Any Like Dx or Drugs in Year 1	50%	50%	50%	52%	49%	51%	53%	54%	44%	48%	52%	50%	——

Table A.5 Yield of Screening Criteria for Cases in Year Two, by Child's Age, 1991-92

	Percent of Children who Were "Cases" (any asthma-like problems or drugs) in Year Two												
Age	2	3	4	5	6	7	8	9	10	11	12	13	14
Asthma Dx in Year 1	___	67%	72%	73%	68%	64%	73%	79%	72%	73%	73%	70%	72%
Asthma or 3 Asthma-like Dx in Year 1	___	65%	70%	71%	67%	67%	73%	77%	72%	72%	72%	70%	74%
Asthma or Any Like Dx in Year 1	___	45%	47%	45%	43%	41%	45%	44%	47%	43%	43%	42%	41%
Asthma, 3 Like Dx or Asthma Drugs in Year 1	___	59%	58%	60%	59%	61%	62%	64%	66%	64%	61%	57%	67%
Asthma, Any Like Dx or Drugs in Year 1	___	46%	47%	46%	44%	44%	45%	44%	48%	46%	45%	41%	45%

Tables A.4 and A.5 show that there is very little difference in the portion of children who remain cases in Year Two between the children diagnosed with asthma in Year One (row one of these tables) and those children combined with the children diagnosed with three or more asthma-like conditions in Year One (row two of these tables). However, many fewer of the children diagnosed with one or two treatments for asthma-like conditions and the children with prescriptions for asthma drugs remain cases in the second year. The yield of the Year One diagnosis screens for Year Two experience is highest for children aged eight and nine, but is not that dramatically different across the age groups. The yield rates are very similar across the two pairs of years. Across the board, approximately 30% of children identified as probably having asthma in Year One have no recorded asthma-like problems of drug treatments in Year Two.

Based on these finding, we have chosen to use the criteria of a Year One asthma diagnosis or three or more asthma-like diagnoses occurring on separate days as our selection criteria for the study population. These criteria yield a study population of 1588 children in 1990-1991 and 2000 children in 1991-1992.

APPENDIX B CATEGORIZATION OF ASTHMA SEVERITY

In a three step process, we adapted the NAEP guidelines for use with claims data. When more than one choice seemed plausible, we tested alternatives. In Step One, we stratified children by how many urgent visit claims[1]*they had during the year. We tested two options here[2*], the **primary method**: zero to one, two, or more than two versus the **first alternative method**: zero, one to two, or more than two. The rationale for the primary option is that children with only one urgent visit claim in a year (and perhaps ever) may not have moderate disease meriting preventive medication treatment. We report the results of both primary and alternative options.

In Step Two, we categorized the preventive medication regimen received by each child during the entire year as suitable for mild, moderate, or severe asthma. We interpreted this as having no preventive medications, one type of preventive medication, or more than one type of preventive medication during the year (see Table B.1 for details). Systemic corticosteroids are not counted as preventive medications because they are also and more commonly prescribed for acute exacerbations. Although all children with asthma should have a Beta-Agonist available for acute symptoms, we chose to stratify disease severity by claims for medications more likely to be used for preventive purposes.

In Step Three, we estimated each child's disease severity by combining urgent visit and medication stratifications, to allow for the possibility of children with untreated, poorly controlled, and well-controlled asthma . Thus, in this study, we assume a child with paid claims for one type of preventive medication had moderate asthma, a child with claims for more than one type had severe asthma. We thus potentially overestimate disease severity, but avoid confounding disease control with underlying disease severity. We also assume no over medication of children, because we can not know that a given child's asthma would be controlled with fewer medications.

A **second alternative method,** omitting the distinction between moderate and severe disease, is also presented. This option was prompted by our concern that our primary and first alternative methods may confound changing single preventive medications with simultaneous use of multiple preventive medications.

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[1] Alternative approaches which weighted inpatient admissions more heavily than outpatient nebulizer treatments in categorizing disease severity yielded a similar distribution of cases.

[2*] The NAEP[16] (p.10) does not quantify urgent visits for the mild disease category. It categorizes <3 urgent visits/year as moderate, >3 as severe, omitting three. We have included the 88 children with three urgent visits in the highest level.

The matches of urgent visit frequency and medication treatment regimen to determine asthma severity are presented in Table B.2. If children with zero or one urgent visit claim are considered mild (primary method, Table B.1), there were 1736 (60%) children with mild and 757 (26%) with moderate asthma. With this method, 742 (26%) children's preventive medications alone determined their severity level.

If only children with no urgent visit claims are considered mild (first alternative method, Table B.1), 1267 (44%) of the population had mild asthma, 1226 (43%) had moderate asthma, and 392 (14%) had severe asthma. Here, the severity levels of 553 (18%) children were determined by their preventive medications alone.

Collapsing categories (second alternative method, Table B.1), the same 1736 children had mild disease as in the primary method, while 1149 (40%) had moderate-severe disease. In this case, preventive medications alone determined the severity level of 699 (24%) children. We follow this categorization in this report.

TABLE B.1
Children's 1992 Disease Severity,
As Determined by Multiple Methods
Number of Children (% of population)

PRIMARY METHOD

PREVENTIVE MEDICATIONS	NUMBER OF URGENT VISITS IN THE YEAR		
0 **1-2** **>2**			
NONE	MILD 1736 (60)	MODERATE^{L} 110 (4)	SEVERE^{L} 57 (2)
1 TYPE	MODERATE 549 (19)	MODERATE 98 (3)	SEVERE^{L} 77 (3)
>2 TYPES	SEVERE 150 (3)	SEVERE 43 (1)	SEVERE 65 (2)

FIRST ALTERNATIVE METHOD

PREVENTIVE MEDICATIONS	NUMBER OF URGENT VISITS IN THE YEAR
0 **1-2**	

>2

NONE	MILD 1267 (44)	MODERATE[L] 579 (20)	SEVERE[L] 57 (2)
1 TYPE	MODERATE 340 (12)	MODERATE 307 (11)	SEVERE[L] 77 (3)
>2 TYPES	SEVERE 83 (3)	SEVERE 110 (4)	SEVERE 65 (2)

SECOND ALTERNATIVE METHOD

PREVENTIVE MEDICATIONS — NUMBER OF URGENT VISITS IN THE YEAR

0-1
>1

NONE	MILD 1736 (60)	MOD/ SEVERE[L] 167 (6)
ANY	MOD/ SEVERE 699 (24)	MOD/ SEVERE 283 (10)

[L] Less preventive medication than frequency of urgent visits warrants.

TABLE B.2
Methods for Determining Disease Severity, Using Number of Urgent Visits and Medication Regimen During Year

PRIMARY METHOD

PREVENTIVE MEDICATIONS — NUMBER OF URGENT VISITS IN THE YEAR

0
1-2
>2

NONE	MILD	MODERATE[L]	SEVERE[L]
1 TYPE	MODERATE	MODERATE	SEVERE[L]
>2 TYPES	SEVERE	SEVERE	SEVERE

FIRST ALTERNATIVE METHOD

PREVENTIVE MEDICATIONS — NUMBER OF URGENT VISITS IN THE YEAR

0
1-2
>2

NONE	MILD	MODERATE[L]	SEVERE[L]
1 TYPE	MODERATE	MODERATE	SEVERE[L]
>2 TYPES	SEVERE	SEVERE	SEVERE

SECOND ALTERNATIVE METHOD

PREVENTIVE MEDICATIONS	NUMBER OF URGENT VISITS IN THE YEAR	
	0-1	**>1**
NONE	MILD	MOD/ SEVERE[L]
ANY	MOD/ SEVERE	MOD/ SEVERE

[L] Less preventive medication than frequency of urgent visits warrants.

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